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Some Effects of Modern Weapons Systems Development on the American Economy

Maurice Braginsky

SOME EFFECTS OF MODERN WEAPONS SYSTEMS DEVELOPMENT ON THE AMERICAN ECONOMY

by

Maurice Braginsky

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Maurice Braginsky

TABLE OF CONTENTS

CHAPTER V (continued)

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The Military Backdrop

The Cold War goes on! And the use of military strength by the United States as a backdrop to other forms of persuation--political, ideological, diplomatic, and economic--continues. The use of a military backdrop as an instrument of national policy will probably continue indefinitely because it is unlikely that the Soviet Union or Communist China will change their objectives of expansionism; it is too much an integral part of their ideology. The easing of tensions between the United States and the Soviet Union since the Cuban crisis in 1962 is perhaps an indication of a change in tactics and diplomacy, but it would be naive to believe that the objective of a Communist-dominated world has been forgotten. Further, the dispute between Communist China and the Soviet Union is not over the objective, but over the means of its achievement, and over who will control the world-wide Communist movement.

The Buildup

As a result of the United States policy to present a strong military posture, there has been a constant buildup of strength over an extended period since the Korean war. First, this buildup manifested itself in the development of weapons systems such as the B-52 and B-47 fleets and the Atlas and Tital missiles and the Polaris and its submarine carrier, along with some mid-range ballistic missiles for deployment in Europe. During

this same period, the development of the century series (F-100, F-102, F-104, and F-105) fighter aircraft also took place. The most recent major weapons development, which is currently being placed into the military inventory at a rapid rate, is the Minuteman. It is anticipated that 800 Minuteman I missiles will be in place by June 1965.[1] Simultaneously, Minuteman II, an improved version, is being developed.

Similarly, in the tactical area, funds are being expended on the development of the TFX (F-111) aircraft, the F-4 aircraft, and on a Navy aircraft called the VAL. In the counterinsurgency area, a developmental program is being established for a small aircraft capable of operating from unprepared surfaces in approximately 300 feet. These are only a few examples among the host of other programs for advanced weapons systems which are currently being planned or already in being.

There has been, in fact, in the past three years, between 1961 and 1964, a substantial buildup in the military strength of the United States. The major buildup has included: (a) A 100 percent increase in the number of nuclear weapons available to the strategic alert forces; (b) a 45 percent increase in the number of combat-ready Army divisions; (c) a 35 percent increase in tactical fighter squadrons; (d) a 60 percent increase in the tactical nuclear forces deployed in Europe; and (e) a 75 percent increase in airlift capability.[2]

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[1]U.S. House of Representatives, Subcommittee of the Committee on Appropriations, Department of Defense Appropriations for 1965, Part 4, Secretary of Defense, Chairman, Joint Chiefs of Staff, 88th Cong., 2d Sess. (Washington, D.C., 1964), p. 30.

[2]Ibid., p. 6.

In addition to this buildup, constant improvements and modifications are being made in weapons which are already in the military inventory. As an example, the 1964 program for modifications considered necessary to improve the capability and to provide for safety and materiel modifications of the B-52 fleet amounted to $272.2 million, and $296.2 million was requested for this same purpose for fiscal year 1965.[3] Similarly, the F-105 aircraft will require $20 million for modification during fiscal year 1965.[4] Further, most other in-place aircraft and missiles require the expenditure of funds for capability improvement as well as for reasons of safety.

The Expenditures

The development and the acquisition programs of major weapons along with their deployment and manning, as well as their modification and improvement programs and the required logistics support, has resulted in an ever-increasing military budget. The extent of these expenditures is revealed in Table 1. These expenditures for military functions, as a percentage of the gross national product, have remained quite constant at about 9 percent since 1955, although they increased from $35.8 billion to $48.3 billion, a total of $13.5 billion, between 1956 and 1963. Further increases have occurred since 1962, as the annual military expenditures for fiscal year 1965 are estimated at $51.2 billion, down from $52.3 for

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[3]U.S. House of Representatives, Subcommittee of the Committee on Appropriations, Department of Defense Appropriations for 1965, Part 3, Procurement, 88th Cong., 2d Sess. (Washington, D.C., 1964), p. 73.

[4]Ibid., p. 67.

Table 1. Expenditures for Department of Defense military functions as a percentage of gross national product, fiscal years 1939-1963 (billions of dollars)

Fiscal year	Gross national product	Dept. of Defense	
		Expenditures	Percent of GNP
1939	88.2	1.1	1.2
1940	95.7	1.5	1.6
1941	110.5	6.0	5.4
1942	140.5	23.6	16.8
1943	178.4	62.7	35.1
1944	202.8	75.8	37.4
1945	218.3	80.0	36.7
1946	202.8	42.0	20.7
1947	223.3	13.8	6.2
1948	246.6	10.9	4.4
1949	261.6	11.6	4.4
1950	263.8	11.9	4.5
1951	310.8	19.8	6.4
1952	338.8	38.9	11.5
1953	359.7	43.6	12.1
1954	362.0	40.3	11.1
1955	377.0	35.5	9.4
1956	408.5	35.8	8.8
1957	433.0	38.4	8.9
1958	440.2	39.1	8.9
1959	466.7	41.2	8.8
1960	494.8	41.2	8.3
1961	506.6	43.2	8.5
1962	539.4	46.8	8.7
1963	568.3	48.3	8.5

Source: U.S. Congress, Subcommittee on Defense Procurement of the Joint Economic Committee, Background Materials on Economic Aspects of Military Procurement and Supply--1964, 88th Cong., 2nd Sess. (Washington, D.C., 1963), p. 3.

fiscal year 1964.[5]

The large expenditures for the defense programs of the United States are bound to have an important impact on the economy--locally, nationally, and internationally. Locally and nationally, this effect is intensified by the uneven geographic distribution of defense-related industry and of military activities, by the disproportionately large claims made by the defense program on some occupational specialties, and by the rapidly changing composition of the defense program as technological innovations create the need for new weapons and facilities and make obsolete the old.

Internationally, the defense program has a significant impact on the continuing deficit of the United States balance of payments. Since 1958, the deficit in the total balance of payments has averaged well over $3 billion annually. The gold stocks of the United States declined by almost $7.5 billion to a level of $15.6 billion, while liquid liabilities to foreigners (a substantial part of which represents a potential claim on the remaining gold stocks) rose by more than $9 billion to over $25 billion. Although defense expenditures are not the only, or even the primary, factor causing the international deficit, they amounted to $18 billion between 1958 and 1964, averaging approximately $3 billion annually.[6]

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[5]U.S. Senate, Subcommittee on Department of Defense, of the Committee on Appropriations and the Committee on Armed Services, Department of Defense Appropriations, 1965, Part I, Procurement Programs Requiring Annual Authorization, Research, Development, Test, and Evaluation Programs, 88th Cong., 2d Sess. (Washington, D.C., 1964), p. 6.

[6]U.S. Senate Committee on Armed Services and the Subcommittee on Department of Defense of the Committee on Appropriations, Military Procurement Authorizations, Fiscal Year 1965, 88th Cong., 2d Sess. (Washington, D.C., 1964), p. 28.

National security expenditures, by virtue of the fact that they are now so large and that they vary in response to forces which are independent of economic conditions and policies, necessarily exercise a limiting influence on the power of the federal government to use expenditure policy for the purpose of promoting full employment or achieving economic stability.

Further, any attempt to use defense expenditures as an instrument of fiscal policy to create a level of demand adequate to keep the economy healthy and growing would probably prove quite unwieldy and might also interfere with the attainment of a military posture consistent with the national policy.

Because expenditures for the national defense approximate 50 percent of the total national budget, and because they have such an impact on our society, it is necessary to examine the environment of weapons development and associated defense expenditures and fully understand some of the major implications involved.

The Pervasiveness

Of course, there are more than expenditures and dollars involved, and the effects of defense spending are all pervasive and affect all major activities in the United States. In an effort to provide an understanding of some of the major implications and effects of expenditures for the national defense there will be an examination of the following major areas:

1. The environment of weapons development and the unique character of the weapons market.

2. The effect upon industry and its mode of doing business in a market in which the government is the sole buyer.

3. The impact on geographical areas.

4. The problems of small business in defense procurement.

5. The implications of government-sponsored research and development on scientific and engineering manpower for industry, higher education, and society at large.

In order to gain an insight into the uncertainties involved in the development of major weapons systems, there will be an examination of the problems involved in accurately predicting the costs, development time, and the performance of these weapons. It is an extremely unpredictable business and the difficulties involved in accureately estimating the capabilities of a potential enemy add even more uncertainty to the environment of weapons development.

Because of the unpredictability involved and because the government is truly a monopsonist in the weapons market, a unique set of government-industry relationships have been established which scarcely resemble the buyer-seller associations common to the ordinary market place. Exploring this area will provide the many reasons for these relationships.

There will also be a review of the changes in the nature of modern weapons systems, i.e. from ordnance-type wheeled weapons and other conventional type weapons to missiles and to systems having great reliance on electronics. This change in the weapons product mix has resulted in major changes in the location of those industries providing weapons products to the government, with major consequences for those areas both

gaining and losing such industry.

Also because of these changes in the nature of weapons systems, weapons contracts have had a tendency to be concentrated in the hands of a relatively small number of large companies. This has in turn had major implications on small business concerns and the number of government contracts they receive. Aware of the possibilities of monopoly, major programs have been established by the government to assure that small business receives an equitable share of expenditures for weapons products.

In view of the large requirements for research and development in the weapons industry, there have been major consequences for industry, manpower, education, and all of society. Many developments resulting from military research have provided benefits to society at large through civilian application. However, there are many complaints that too much effort is being applied to military research and development to the detriment of economic progress in the civilian sector.

The great requirements for scientific and engineering manpower for military research and development has had a major impact on education. Further, the amount of military research and development, along with other governmental research, has had its effect on the universities. A searching analysis of this area will reveal the extent of these effects.

Although not to be discussed, recognition must also be given to the fact that the research and development programs associated with modern weapons systems development has had great impact on automation, technology, science, and engineering, and the introduction of new products and processes. Further, it has had a large impact on the educational curriculum

for scientists, engineers, and technicians, which must respond to the changing technology being brought about by such research and development.

There will be no attempt to resolve the question of whether expenditures for weapons systems or whether other military outlays are too great or too small; an answer to this question would require much more time and space than is normally allotted to a thesis. Further, it is doubtful that this question can even be answered. However, it is hoped that a thorough examination of the areas briefly discussed in the last several paragraphs will provide an insight into many of the ramifications of modern weapons systems development and some of its major effects on the American economy. This thesis also proposes to indicate, wherever appropriate, government reaction to the problems and pressures resulting from the development of modern weapons systems.

CHAPTER II

THE BACKGROUND OF WEAPONS SYSTEMS DEVELOPMENT

Uncertainty of Weapons Development

There has been a high degree of uncertainty in the development of modern weapons systems. Uncertainty in this context, is defined as the relative unpredictability of the outcome of a contemplated action and is not meant to reflect the state of mind of the decision-maker. The major uncertainties involved in the development of weapons systems in the 1950's and early 1960's are related to time, cost, and performance factors. Major development programs have often exceeded original cost estimates by 200 to 300 percent and schedules have been retarded from one to three years when compared with original predictions. These facts are well known to most government and industry managers who are concerned with weapons systems development.

These uncertainties have been well documented. The major findings of two major studies of this problem are discussed in the following paragraphs and sections. These studies were prepared by the Rand Corporation[1] and by Peck and Scherer[2] in their 3-year research project on weapons acquisition.

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[1]A. W. Marshall and W. H. Meckling, Predictability of the Costs, Time and Success of Development, P-1821, Economics Division, The Rand Corporation, Santa Monica, California, October 1959.

[2]Merton J. Peck and Frederic M. Scherer, The Weapons Acquisition Process: An Economic Analysis (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1962).

In their study of 12 weapons systems, Peck and Scherer considered three measures to ascertain the predictability or the unpredictability of the outcome of weapons programs. They were: (a) Development time, or the interval between the start of a program and the availability of operational weapons; (b) the costs development; and (c) quality, or the expected performance of the resulting weapon.[3] To determine the predictability of these variables, a comparison of the initial predictions as documented in the pertinent contracts had to be compared with the actual time, cost, and quality outcomes.

Some of the comparisons of time, cost, and quality outcomes with their initial predictions had to be viewed with reservation because of the problems involved in obtaining satisfactory data, for neither the original estimates nor the final outcomes were quite comparable between programs. The fact that initial predictions were often made at varying stages of progress of different weapons development programs presented a problem. In aircraft development programs, the development and production of 5 to 15 prototypes had been sufficient to provide some reasonable indications of the total anticipated development costs. However, in many missile programs the entire research and development effort (including the production of initial prototypes) were not contained in a single contract. Other factors causing difficulties in the comparison of predictions with actual outcomes were instances where only a specified "level of effort" was required for each year and where no total development costs were specified. Sometimes, programs were submitted for planning purposes only and costs were deliberately understated by contractors to

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[3] Ibid., p. 19.

"sell" the program. Conversely, the military proponents of a particular program submitted low cost and time estimates to assure adoption of a particular program. Consequently, these estimates could not be used as a basis of comparison with the final outcomes of time and cost.[4]

A further problem encountered was the determination of "initial operational capability," a term which cannot be precisely defined. Is the definition of this term applicable to the availability of a single operational missile or some larger number of missiles whose reliability is not exactly known? The answer to this question is not easy. Similarly, the determination of final costs are not easily determined because the extraction of precise costs from contractual documents may be made difficult by the inclusion of joint costs, overhead, and the lumping together of production and development costs. In addition, the reorientation of programs numerous times for nontechnical reasons causes frustration of time, cost, and performance data. It was therefore necessary to introduce some subjectivity to estimate "original" predictions as well as "actual" outcomes in assessing the cost, time, and quality data in their study of twelve major weapons systems development programs. This subjective element is therefore present in the prediction error data reflected in Table 2.

Despite this subjectivity, the truth is that predictions have been quite inaccurate. As reflected in Table 2, it is not uncommon for final costs to have exceeded estimates by 200 to 300 percent. Further, development time appears to have exceeded original estimates by as high as 130 percent--the average being about 36 percent.

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[4] Ibid.

Table 2. Development cost and time variance factors in twelve weappns programs

Program	Development cost factor[a]	Development time factor[b]
A	4.0	1.0
B	3.5	2.3
C	5.0	1.9
D	2.0	n.a.
E	n.a.	.7
F	7.0	1.8
G	3.0	1.3
H	2.0	1.0
I	2.4	1.3
J	2.5	1.3
K	.7	1.0
L	3.0	1.4
Average	3.2	1.36

[a]Actual cost divided by original cost estimate.

[b]Actual time divided by original time estimate.

Source: Merton J. Peck and Frederic M.Scherer, The Weapons Acquisition Process: An Economic Analysis (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1962), p. 22.

Peck and Scherer found it difficult to compile a comparable set of factors to those contained in Table 2 for performance outcomes of weapons development programs because of the qualitative nature attached to these outcomes. Their analysis of some key performance characteristics, such as airspeed, range, altitude, and accuracy, for the twelve programs reflected in Table 2 varied from .80 to 2.00. This indicated that actual performance fluctuated from approximately 100 percent above to about 20 percent below what was originally predicted. Actual performance often exceeded original predictions and the central tendency was on the favorable side.[5]

[5]Ibid., p. 23.

To combine the results reflected in Table 2 pertaining to time and cost outcomes with those in the previous paragraph related to performance variables, it can be seen that errors are greatest for cost (only one program of the twelve cost less than estimated, while the average cost factor was 3.2), less for time (average time factor was 1.36) and least for performance. In weapons development great importance has usually been attached to meeting performance and time requirements. Cost, then, has traditionally been the factor with the greatest variability because by the use of additional funds, a development project could be made to meet or exceed performance and/or time objectives. This has largely been responsible for the greater unpredictability of the cost dimension.

The study by Marshall and Meckling parallels the results contained in the Peck and Scherer study in many respects. In regard to costs, their study indicated that in the early stages of development, cost estimates were based on current design and the currently planned program for development. All costs are based on the proposed system and its components as presently conceived and aggregated. However, as development progresses, the initial plans and designs may change. These changes may be due to unforeseen technical difficulties, or because the customer (military services) requires modifications to keep pace with the changing intelligence of military capabilities, new operational concepts, or new technological possibilities which require the addition of numerous components and devices not originally planned for. The weight, form, and size may differ tremendously at the completion of the program. Another complicating factor is that the number of test articles

which may have initially been designated at fifteen may have gone up to forty-five by the end of the development program. Such changes have a great effect on costs and have occurred quite frequently. Consequently, the costs finally incurred were not the cost of the initial design or development plan, but the cost of what was finally produced or the cost of whatever program was actually conducted.[6]

Any development program will have a basic uncertainty attached to it because of its nature. A greater variability will exist in the time, cost, and performance factors, the greater the technological advance being sought. For systems which demand many new ideas and major improvements, the errors in cost predictions have tended to be larger.[7]

Marshall and Meckling's study shows that the cost variances were greater for missile programs which sought a higher order of advancement than they were for flighter and bomber programs. As shown in Table 3, the original estimates of the cost of production for four cargo and tanker programs showed an average factor of 1.2, or a variance of 20 percent, against an average factor of 6.4 and 4.1. This indicates variances of 640 percent and 410 percent for the six missile programs which were studied. These two sets of factors (A and B) were prepared by two different individuals.

Peck and Scherer also indicated that numerous external occurrences altered the course of developments programs with consequent effects on cost and time predictions. The major external causes are: Advances in technology, obsolescence, changing intelligence of enemy capabilities,

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[6]Marshall and Meckling, p. 6.

[7]Ibid., p. 22.

Table 3. Total factor increases in average cumulative cost of production (adjusted)

Fighters	Factors A	Factors B	Bombers	Factors A	Factors B	Cargoes and tankers	Factors A	Factors B	Missiles	Factors A	Factors B
1	3.9	4.0	1	6.2	4.0	1	1.4	1.6	1	14.7	6.4
2	2.6	2.5	2	2.8	2.8	2	1.5	1.5	2	9.4	6.0
3	2.0	2.0	3	1.1	1.2	3	1.0	.9	3	4.4	2.7
4	1.5	1.5				4	1.0	.8	4	7.2	7.1
5	1.7	2.1							5	1.5	1.3
6	1.2	1.2							6	1.1	.8
7	1.0	.8									
8	1.0	1.0									
9	1.1	.6									
Means	1.8	1.7		3.4	2.7		1.2	1.2		6.4	4.1

Means--all classes

A	B
3.2	2.4

Source: A. W. Marshall and W. H. Meckling, Predictability of the Costs, Time, and Success of Development, P-1821, Economics Division, The Rand Corporation, Santa Monica, California, October 1959, p. 14.

changes in defense policies, budget changes and fiscal reprogramming, and changes of key officials.[8]

In summary, these two studies reflect the basic inability of the Department of Defense in the past to accurately estimate and control cost, time, and performance outcomes of major development programs.

The Department of Defense, however, recently has taken the view that something can be done to reduce many of the uncertainties involved in weapons systems development as reflected in the two studies which have been reviewed. The Department of Defense has indicated that poor planning, unrealistic schedules, unnecessary design changes, and large

[8]For a full discussion see Peck and Scherer, pp. 48-52.

cost overruns have constantly disrupted the efficient conduct of development programs. These difficulties have stemmed mainly from inadequate planning and unwarranted haste in starting large-scale development programs. Sometimes even production was a difficulty, particulary before a clear definition of what was wanted and before a clear determination was made of a technological basis on which to develop a system. Accordingly, a discussion of the programs designed to overcome these deficiencies will follow.[9]

The Need to Improve Planning

In view of the inability of the military services to adequately predict and control time, cost, and performance factors, the Department of Defense has taken the view that the basic defects were related to inadequate planning and the identical treatment of all development work.

The Department of Defense indicates that both government and industry have believed that planning for innovation and invention could not be accomplished. Forced to operate under tight delivery schedules, they have allocated large amounts of resources to projects without the firm assurance of success and without giving adequate thought to the best method to achieve stated goals. Contracts for operational hardware were let before the feasibility of accomplishing the basic technical requirements had been established. This type of planning was not conducive to accurate pricing, and constant contingencies, changes, etc., prevailed throughout the live of the development.[10]

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[9]U.S. Senate, Subcommittee of the Committee on Appropriations, Department of Defense Appropriations for 1964, HR-779, 88th Cong., 1st Sess. (Washington, D.C., 1963), pp. 73-74.

[10]U.S. Department of Defense, Incentive Contracting Guide (Washington, D.C., 1963), p. 1.

Revising the Development Concept

In view of the large expenditures involved in research and development (more than $6 billion in fiscal year 1963),[11] the need of the military services to have better control over their resources, and to enable better planning and control over time, cost, and performance factors, the Department of Defense reorganized their concept of conducting development work.

Whereas in prior years development programs were treated as a single, broad category, now they are subdivided into six categories: "(1) research, (2) exploratory development, (3) advanced development, (4) engineering development, (5) management support, and (6) operational system development."[12] A brief description of the various categories of development programs follows:[13]

(1) Research. Includes efforts toward increased knowledge of natural phenomena and environment and efforts toward solving problems in the physical, behavioral, and social science that have no clear direct military application.

(2) Exploratory development. Aimed at solution of specific military problems, short of major developments. Includes studies, investigations and minor development efforts.

(3) Advanced development. Aimed at development of hardware for

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[11] U.S. Congress, Subcommittee on Defense Procurement of the Joint Economic Committee, Background Materiel on Economic Aspects of Military Procurement and Supply, 1964, 88th Cong., 2nd Sess. (Washington, D.C., 1964), p. 27.

[12] U.S. Department of Defense, Instruction 3200.6, Reporting of Research, Development and Engineering Program Information (Washington, D.C., 1962), enclosure 3, pp. 1-2.

[13] Ibid.

experimental or operational test. Items to be developed are for test or experimentation as opposed to items to be developed for service use.

(4) Engineering development. Includes development programs to be engineered for service--but still not approved for production or operation.

(5) Management and support. Includes R&D effort in support of installations or operations required for general R&D use. Included are such items as test ranges, military construction, maintenance support of laboratories and operations maintenance of test aircraft and ships.

(6) Operational system development. Full effort toward development, engineering and test of systems, support programs, vehicles and weapons that have been approved for production and use.

The first four of these categories are phases in which an evolutionary process takes place which translates ideas into useful military hardware. Each of the six phases above uses a different management technique. The first two phases of research and exploratory development generally do not prescribe goals, milestones, or schedules. Control of projects in these two categories is accomplished on a level-of-effort basis.

A questioning in depth of the potential military value of specific applications and techniques takes place in the third state (advanced development) as ideas progress to the development of hardware for experimental tests. At the same time, costs of the most promising applications are estimated to ascertain whether the project, if fully developed and placed into production and service, would be worth the cost.

During the fourth state (engineering development) when a system

is to be fully engineered for operational use, the necessary allocations of resources are made to the applicable project. Accordingly, before full-scale development is begun, operational requirements and cost effectiveness of the system must be defined, and goals, milestones, and time requirements must be firmed up. At this point, a "project definition phase" is required.[14]

Project Definition

The "project definition phase," is defined as "a formal step preceding full-scale development, during which preliminary engineering and contract and management planning are accomplished in an environment that encourages realism and objectivity."[15]

The "project definition phase" unites under a single plan for the government and industry what is wanted, what the design will be, how it is to be built, when it is wanted, and the cost of the development. It describes the management techniques to be used for control of the development. After this plan has been completed, initiation of the management and support phase, and the operational systems development, follow as time progresses.

The use of the "project definition phase" would have to be undergone before any "metal bending" was done. Thus, a more precise evaluation of all aspects of the new development prior to a major commitment of

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[14]Department of Defense Appropriations for 1965, Part 4, Secretary of Defense, Chairman, Joint Chiefs of Staff, p. 232.

[15]U.S. Department of Defense, Directive 3200.9, Project Definition Phase (Washington, D.C., 1964), p. 1.

resources is made possible. The number of costly projects can be reduced which might otherwise require subsequent reorientation, stretching out, or termination.[16]

This approach recognizes that technological evolution cannot be planned. Some of the research and development efforts in the earlier phases will not lead to any useful products and some unanticipated needs will be encountered along the way and some developments will have to be culled out. Further, by the use of the first three phases as "building blocks" to define and manage large scale programs, there will be a tendency to avoid costly and inefficient crash programs and telescoped development-production efforts.[17]

This approach of precisely defining exactly what is wanted, when it is wanted, and how it will be controlled and managed is quite different than the approach taken in the past as reflected in the following statement:

> Contracts . . . are necessarily cost-plus-a-fixed fee contracts, because no adequate basis exists for fixed price negotiations. . . . We are demanding tomorrow what was unheard of yesterday and where the passage between the two is filled with unknowns, the costs of performance cannot be estimated with reasonable accuracy.[18]

The use of "projected definition" is designed to overcome the

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[16]U.S. House of Representatives, Subcommittee of the Committee on Appropriations, Department of Defense Appropriations for 1964, Part 1, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 161.

[17]Department of Defense Appropriations for 1965, Part 4, Secretary of Defense, Chairman, Joint Chiefs of Staff, p. 232.

[18]U.S. Congress, Subcommittee on Defense Procurement of the Joint Economic Committee, Impact of Defense Procurement, 86th Cong., 2nd Sess. (Washington, D.C., 1960), p. 326. Statement by Perkins McGuire, former Assistant Secretary of Defense (Supply Logistics).

problems indicated in the above quote. Its use in construction with incentive type contracts will be discussed later in the chapter. In the next section there will be a discussion of cost-plus-fixed-fee type contracts, and the reasons for their widespread use in the past in major development programs.

A Single Buyer: Monopsony

There is but one ultimate consumer of advanced weapons systems in this country--the United States Government. This type of market is quite unlike the consumers market with which we are familiar. Although there are entrepreneurs in the weapons business, the government or buyer generally decides whether a new weapons system is required, thereby taking the initiative on new products. In addition, by the use of progress payments and the provision of government facilities and equipment, developmental outlays have been largely financed by the buyer. This precludes the seller from offering a finished product which the buyer can accept or reject. Instead, development costs have been provided by the buyer before it is known what the ultimate performance or desirability of the product will be. The government has frequently changed, reduced, or cancelled the program before its completion. Instead of a price determination by many buyers and sellers in the market, the price of the weapon has been largely determined by contractor costs actually incurred, plus a fee bargained for in advance (cost plus fixed fee contracts). Further, these methods reduce the risks taken by the seller. These are the major factors which preclude the existence of true market system in the weapons industry.[19]

[19]Peck and Scherer, p. 60.

The Administration of Weapons Systems Development

Because of the lack of a true consumers market, the government has established an administrative substitute with a unique set of relationships between it and the weapons systems industry. This administration has predominantly taken the form of contracts known as cost-plus-fixed-fee in the past. Under this type of contract the corporation receives reimbursement for all costs incurred in the development and production of weapons systems, plus a fixed fee which has been determined in advance. The major reason for using this type of contract has been the difficulty in specifying exactly what is wanted in advance. This is in contrast to the type of contracting undertaken when a contract is agreed upon for a specific product or task, as is commonly done in ordinary commercial practice. For the latter, it is entirely possible for competitors to submit fixed price bids, and the buyer and seller will agree upon the product before it exists. Under the former, where there is uncertainty regarding the exact specifications of the end product, business is unable to assume the risk of bidding on a fixed price basis, and government does not expect industry to assume such risks.

Since a fixed price and exact detailed specifications cannot be established in advance for entire weapons systems and because of the large dollar amounts involved, the Military Services are placed into a direct, daily intimate relationship with the developers and producers of these systems. There is little doubt that the Services must, to a considerable extent, control component design and development since they are so critical to the efficient performance of weapons systems.

The Services, rather than the contractor, know what performance characteristics are critical under combat conditions. It is difficult to escape the conclusion that considerable direct contact between the Services and the producers of components and equipment for weapons systems is necessary.

Weapons systems development not only involves considerable contact, but also obviously involves a great deal of control over individual contractors by government procurement agencies. The Services frequently place constraints on management which are not customary in the private economy. Some of these stem from the insistence that they control performance characteristics and, therefore, design. Some prime contracts specify not only what is to be supplied but how--with what materials, how much subcontracting, which subcontractors, and so on. The cost-plus nature of these contracts requires the Services, prodded by the General Accounting Office (GAO), to see that all incurred costs are "legitimate." A contracting officer enforces rules designed to prevent waste or fraud, and approves or disapproves every items of expenditure by both prime contractor and subcontractors. He even controls (in theory) the wages and salaries to employees. This is somewhat removed from the term "free enterprise" as the term is usually understood, and as it is practiced elsewhere in the economy.[20]

The monitorship of large contracts is achieved through the use of Air Force Plant Representative Offices. A typical office might have 8 military personnel (officers) and 142 civilian government employees; 27 civilians in the Contract Division, 12 civilians in the Production

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[20]Charles J. Hitch and Roland N. McKean, The Economics of Defense in the Nuclear Age (Cambridge, Mass.: Harvard University Press, 1960), p. 231.

Division, 74 civilians in Quality Control Division, 10 civilians in the Property Administration Division, etc. There may also be 10 civilian Air Force auditors in the office.[21] From the division tittles, it is obvious that costs, delivery schedules, quality performance, etc., are monitored very closely--intimately and constantly by government representatives. The property function exists to monitor government industrial property and government-furnished parts purchased from other contractors, which are often provided on large contracts.

Industry, to a great extent, would like to have many of the constraints removed in their government contracts. But the Congress and the General Accounting Office, because of the huge expenditures involved, are constantly reviewing the Service's procurement practices, and through constant prodding the rules appear to be tightening. An idea of the magnitude of these expenditures may be gleaned from the following figures for only two weapons in the nation's arsenal. The amounts expended on the Atlas program to date are $3.9 billion, with final costs estimated at $5.2 billion, while the Minuteman estimate is $5.5 billion.[22]

The public view regarding contractor surveillance is summarized as follows:

> The relaxation of contractual restraints, while highly desirable in itself, depends upon the development of satisfactory

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[21]U.S. House of Representatives, Subcommittee on the Committee on Appropriations, Department of Defense Appropriations for 1957, Procurement Policies and Practices of the Department of Defense, 84th Cong., 2nd Sess. (Washington, D.C., 1946), p. 119.

[22]U.S. Senate, Permanent Subcommittee on Investigations of the Committee on Government Operations, Pyramiding of Profits and Costs in the Missile Procurement Program, Part 3 (Atlas Program), 87th Cong., 2nd Sess. (Washington, D.C., 1962), p. 572.

> substitutes for "cost plus." Rightly or wrongly (we think rightly), the Congress and the public are determined that contractors be kept from cheating on cost-plus, even to the point of being willing to sacrifice some efficiency to prevent fraud (or just excessive pocketlining).[23]

In regard to pocket-lining, a major tool being used by Congress and the Services to ascertain the appropriateness of contract charges is the audit procedure. Congress, through the use of the General Accounting Office, has audited many contracts and disclosed numerous instances of overcharges by weapons contractors and subcontractors. A recent disclosure by this instrument of Congress asserted that Melpar Inc., which was developing a B-58 aircraft bomber recording system, charged the Air Force a price which exceeded incurred costs by $821,200, or 41 percent. This resulted in a detailed audit and negotiation of price adjustments between the Air Force and Melpar.[24]

Routinely, the Services audit their contracts, and many audits result in re-negotiated prices and recovery of charges from contractors. In fiscal year 1962, the Air Force negotiated price reductions in the amount of $438 million as a result of 228 audits; in fiscal year 1963 this total was $487 million for 250 audits. During these two years there were 10,809 contractors and subcontractor's cost estimates subjected to Air Force audit review.[25]

In addition to the constraints of cost-reimbursement-type contracts upon industry, the following disadvantages to their use are summarized in this statement by the Assistant Secretary of Defense (Installations and Logistics).

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[23]Hitch, p. 233.

[24]Department of Defense Appropriations for 1965, Part 3, Procurement, p. 18.

[25]Ibid., p. 24.

> This type of contract has well-known disadvantages. It provides little or no incentive for private managers to reduce costs or otherwise improve efficiency. Indeed, the cost-plus-fixed fee contract in combination with strong pressures from governmental managers to accomplish work on a rapid time schedule, probably provides incentives for raising rather than for reducing costs. If a corporation is judged in terms of whether it accomplishes a result by a given deadline rather than by whether it accomplishes that result at minimum cost, it will naturally pay less attention to costs and more attention to speed of accomplishment. On the other hand, where there is no given deadline and cost-plus-fixed-fee contract, it may serve to prolong the research and development work and induce the contractor to delay completion.[26]

Incentive Contracts

Due to the widespread dissatisfaction with cost-plus-fixed-fee contracts, the Department of Defense has been promoting the use of incentive-type contracts. The incentive principle holds, in brief, that a contractor should be motivated, in calculable monetary terms:

> (1) To turn out a product that meets significantly advanced performance goals, (2) to improve on the contract schedule up to and including final delivery, (3) to substantially reduce the costs of the work, or (4) to complete the project under a weighted combination of some or all of these objectives.[27]

If the government can precisely define its objectives requirements, time tables and management controls through the application of "project definition," it will probably enable the greater use of incentive-type contracts. By taking the time to closely plan all facets of a development project, the ability to establish realistic targets for use

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[26] U.S. House of Representatives, Subcommittee of the Committee on Government Operations, Systems Development and Management, Part 2, 87th Cong., 2nd Sess. (Washington, D.C. 1962), p. 551.

[27] Incentive Contracting Guide, p. 1.

with incentive-type contracts should be improved. In addition, the Department of Defense has begun to implement other management controls and are making them an integral part of contracts which must be defined and spelled out during the "project definition" phase. These techniques along with a precise definition of goals and targets should help improve the predictability of the cost, time, and performance factors which have caused major problems in the past.

In essence, nearly all incentives take the form of a sharing arrangement, expressed as a percentage ratio. As an example, if a 60/40 cost sharing arrangement was agreed upon, the government would pay 60 cents and the contractor 40 cents of every dollar by which actual costs increased. Conversely, for every dollar saved, the government would retain 60 cents, and the contractor's profit (or fee) would increase by 40 cents. In other words, over the range of costs where the sharing formula is applicable, the contractor must look at every dollar he spends as though 40 cents were his. His profits are thus tuned to the contractor over a variable on which his management skills can have a significant effect. Incentive patterns may also be established for equipment performance as well; specific standards must be established for these performance goals along with predetermined test procedures. The incentive targets can be tied into such characteristics as speed, range, payload, or maneuverability. Delivery incentives may be related to end-item delivery, test completions, or possibly only the acceptance of the first prototype.[28]

There are two basic types of incentive contracts. They are known

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[28] Ibid., p. 10.

as the fixed-price-incentive-firm contract and the cost-plus-incentive-fee contract. Under the first type of contract, the government and the contractor must negotiate four basic elements. These are:

1. Target cost (against which to measure final costs).
2. Target profit (a reasonable profit for the work at target cost).
3. Ceiling price (the total dollar amount for which the government is liable).
4. Sharing formula (the arrangement for establishing final profit and price).[29]

Upon completion of the work, the contractor and the government negotiate the final costs, sharing the overruns or underruns based on the agreed-upon formula. To illustrate, assume that the target cost is $100,000, the target profit $10,000, the price ceiling $118,000, and the sharing formula is 75 percent for the government and 25 percent for the contractor. Under this formula, the contractor would keep 25 percent of every dollar saved. In order to earn a profit of $12,000, he would have to reduce costs by $8,000 below target, or down to $92,000. Since there is no profit ceiling, profits could increase indefinitely as the dollar underrun increased. Conversely, an overrun of $8,000 above target cost would reduce his profit to $8,000. With an overrun of $18,000 he would lose money, since this type contract does not provide for a minimum profit. Regardless of final contractor cost, the government's liability cannot exceed $118,000, and the contractual specifications must be met.

The cost-plus-incentive-fee contract uses the same type of sharing formula as the fixed-price-incentive-firm contract. The formula determines the fee payable to the contractor on the basis of the relation between

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[29] Ibid., p. 11.

target costs and total allowable costs. In contrast to the fixed-price-incentive-firm contract, where no floor or ceiling profit is negotiated, this type contract states the minimum and maximum fees allowable. In development contracts, the maximum is limited to 15 percent of the target cost and on production contracts it is limited to 10 percent. In this type contract, the sharing formula may be expected to vary greatly, depending on the degree of confidence the government has in its estimate of costs versus the degree of confidence the contractor has in its estimate. This may make the range of costs over which the incentive provisions operate quite extensive.[30]

In most large development contracts the incentive will not only embody cost, but performance and schedule incentives as well. The purpose of combining these incentives is fairly obvious. A satisfactory product or service is desired at a reasonable cost and within certain time limits.

There has been a dramatic increase in the use of incentive-type contracts since 1961. Between 1955 and 1961, the use of cost-plus-fixed-fee contracts increased from 19.7 to 38 percent of the total contract awards. However, between 1961 and 1963, this percentage decreased to 20.7 percent. A goal of 12.3 percent has been established for fiscal year 1965, with cost-plus-fixed fee contracts to be awarded only for exploratory and research study projects.[31]

A major cause of cost overruns on major development programs has been attributed to the widespread use of cost-plus-fixed-fee contracts.

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[30] Ibid., p. 12.

[31] Department of Defense Appropriations for 1965, Part 4, Secretary of Defense, Chairman, Joint Chiefs of Staff, p. 278.

The use of these contracts resulted in a lack of detailed advance planning which is a requisite for the close pricing of contracts and the close supervision of contractor performance. The open-ended arrangement of reimbursable-type contracts also encouraged the premature initiation of development projects. This provided no incentive to the Services to define precisely in terms of performance characteristics, delivery dates, and costs what was to be procured.[32]

The use of incentives has not only resulted in more adequate definition of the end product, but has also reduced costs considerably. "And for each contract dollar we shift from cost plus to fixed price or price incentive our evidence shows we have saved about ten cents and we have shifted something on the order of $4 billion per year so far."[33]

A Weapons Systems Development Program

The Secretary of Defense indicates the extent of surveillance and control the Services maintain over contractors in the development of major weapons systems in the following statement:

> . . . use of performance and evaluation review techniques (PERT) which identify the thousands of important events or decision points which must be monitored continuously both by Department of Defense and its contractors during the course of a major development project. In the Titan III program, for example, biweekly reports are received from the prime systems contractor on 2,500 key events indicating cost and time progress.[34]

The following account of the Minuteman program will reveal in

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[32] Ibid.

[33] Ibid., p. 278. Statement by the Secretary of Defense McNamara.

[34] Ibid., p. 279.

greater detail the extent of the relationships between government and industry, and the control the Services exercise over a major weapons development program.

The primary agent for the government in its contacts with industry in the Minuteman program is the United States Air Force, through the Air Force Systems Command (AFSC) and the Air Force Logistics Command (AFLC). Air Force regulations describe their missions respectively as follows:

> The overall mission of the Air Force Systems Command is to advance aerospace technology, adapt it into operational aerospace systems, and acquire qualitatively superior aerospace systems and material needed to accomplish the Air Force mission.[35] The overall mission of the AFLC is to provide logistic support and services for USAF organizations and systems and material.[36]

AFSC is responsible for the initial research and development and making the weapon systems operational for use by the Air Force. AFLC is responsible for logistic support, modifications, and improvements in the systems after operational capability has been achieved. These responsibilities place these two Air Force commands into a daily, intimate relationship with the aerospace industry. The Armed Services Procurement Regulations and the Air Force Procurement Instructions set up the basic rules for this relationship.

The Minuteman program is managed by the Ballistic Systems Division (BSD) of the Air Force Systems Command Technology Laboratories (STL), a non-profit subsidiary of Thompson Ramo Wooldridge Corporation. The

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[35]Department of the Air Force Regulation 23-8, Organization and Mission--Field, Air Force Systems Command (Washington, D.C. 1962), p. 1.

[36]Department of the Air Force Regulation 23-2, Organization and Mission--Field, Air Force Logistics Command (Washington, D.C., 1962), p. 1.

Ballistic Systems Division is the executive agent responsible for accomplishment of all phases of the development program-design and manufacture of the missile--all its ground equipment, design and construction of development and operational system facilities, and provision of logistics support and trained personnel to operate and maintain the system. Further, it provides overall program planning, direction, control and business management, including the formal contracting function and logistic support. The Space Technology Laboratory provides systems engineering design coordination and technical direction.[37]

The Boeing Corporation, one of several associate contractors in the Minuteman research and development program, is primarily responsible for weapon system integration and provides for design integration, physical integration of subsystems, and the testing out of the total weapon system. Additionally, Boeing is responsible for the development of the launch and controls systems. Each of the other associate contractors is responsible for the development of the other major subsystems. Boeing and the other associate contractors have a number of first-tier subcontractors to develop various components and to furnish equipment, materials, and services of various kinds. Additionally, the subcontractors are supported by second- and third-tier subcontractors according to the requirements of the development program.[38]

BSD, assisted by STL, retains control of the program and coordinates all basic technical designs. This group constantly evaluates all

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[37]U.S. House of Representatives, Subcommittee for Special Investigations of the Committee on Armed Services, Weapons System Management and Team System Concept in Government Contracting, 86th Cong., 1st Sess. (Washington, D.C., 1959), p. 208.

[38]Ibid., p. 209.

factors affecting optimization of weapon systems design and constantly reviews design and development programs of all the associate contractors. Boeing, as the assembly and test contractor, is required to maintain close continuous coordination with the BSD/STL group. The initial plan was developed by the Air Force complex and forwarded to the associate contractors, to be used as a guide in working out their respective detailed plans. The associate contractor plans were then submitted to the Air Force where they were integrated into an overall master plan, which upon release became the basic authority and direction for implementation of the contract. Key dates were established for use as targets and as a basis for measuring progress. The plan is a management tool for the Air Force and guidance for the contractors. The progress is monitored and compared with milestones in the master program plan.[39]

Regular technical directive (TD) meetings, chaired by STL, are held to frequently reviewed program status, progress, and problem areas with all associate contractors. The minutes from these meetings and other STL instructions become technical directives and are processed to become legal amendments to the prime contract. By means of these meetings, progress is monitored and technical direction is provided. Close relationships and continuing coordination is achieved. The system is designed to shorten lines of communication and facilitate prompt decision making. Complete control of subcontracting is retained by the contracting agency, BSD, and all direct contract charges and overhead expenses are audited by Air Force inspection personnel who are resident at the contractor's plant as standard routine procedure.[40]

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[39] Ibid.

[40] Ibid.

The competition in obtaining such a contract is keen. The manner in which Boeing obtained this contract follows: A preproposal briefing was held at which 22 companies were represented. Companies present were in no position to know how many companies were sent the request for proposal, although it was reasonable to assume that the request for proposal was sent to more firms than those present. Eleven companies responded to the request for proposal. These companies included a substantial segment of American industry--General Motors, Bendix Aviation, Douglas Aircraft, General Electric, Martin, Boeing, Chrysler, Convair, McDonnell, North American Aviation, and Northrop.[41]

After the written proposals were submitted and evaluated, each prime contractor was invited to brief the Air Force Proposal Board on his proposal. The Board was made up of eight Air Force officers and two government civilian employees. Organizations represented on the Board were: The Air Force Systems Command, the Air Force Logistics Command, the SAC (Strategic Air Command, potential user). After about five weeks of study, Boeing was informed they had been awarded the assembly and test contract. Boeing then worked with the Air Force in developing proposed statements of work for subcontractors. It was then Boeing's task to integrate the associate subcontractor system into a workable overall system acceptable to the Air Force.[42]

The following statement by Major General Sam Phillips, former director of the Minuteman program, indicates some of the relationships established between industry and government as well as those corporations

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[41] Ibid., p. 211.

[42] Ibid.

having responsibility for the major subsystems:

> Our approach now, is for the Ballistic Systems Division (BSD) Program Office to be responsible for system management. We have contracted with STL to do our systems engineering and technical direction of our associate contractors. The STL military project teamworks closely together here in Inglewood to direct and coordinate the activities of our six prime associate contractors plus certain other prime contractors such as the architect engineer. Boeing is responsible for systems test operation, for physical integration of the system, for assembly and checkout in the field. Autonetics has the guidance and control system, and the ground support equipment uniquely associated with guidance and control. Thiokol has the first stage engine, Aerojet the second, and Hercules Powder the third stage. Avco has the re-entry unique to the handling and check-vehicle, plus such ground equipment out of the re-entry vehicle with its warhead. Parsons Company is the architect engineer.[43]

There is little doubt that the development of major weapons systems is a complex project which requires a great deal of centralized planning and control. It is for this reason that the government-contractor relationship cannot be the same as the typical buyer-seller relationship. Further, the uncertainties involved and the high costs of development further indicate the need for close surveillance and control.

The recent changes effected by the Department of Defense in its concept of research and development, with the application of "project definition" assure the continuance of close surveillance and control over contractors participating in development programs. It is, therefore, unlikely that the constraints placed on the weapons industry will be relaxed in the foreseeable future.

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[43]Philip Geddes, "Minuteman Management, The View from the Top," Aerospace Management , May, 1962, p. 28.

CHAPTER III

IMPACT ON GEOGRAPHICAL AREAS

The Background

Economic changes in specific geographical areas are subject to various forces. Technology creates new demands--both product and service--and displaces old ones. Specialized resources attract people, business, and industry. Major governmental decisions, local, state, and national, encourage or stifle economic growth. The population increases, its income grows and it improves its skills; or perhaps there is a decline in all these as people leave seeking better economic alternatives. Initiative on the part of local promotional groups may attract activities that represent net additions to the national product or mere relocations from other less favored areas.[1]

Small geographical areas have a common economic feature. In addition to the response to the broad general forces of development and fluctuation, these areas are more often than not peculiarly subject to stimuli or slowdown by outside forces. Growth or decline in their economies are likely to be a somewhat erratic and typically unbalanced response to global, national, regional, and state patterns of which it is a minute and often specialized subpart.[2] Economic responses such as these have resulted from the development of modern weapons systems.

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[1]C. P. Blair, Economic Growth Projections for the Dallas, Fort Worth, and Houston Trading Areas (Austin: Bureau of Business Research, The University of Texas, 1961), p. 1.

[2]Ibid.

Effects such as those described above have been felt in individual communities and regions throughout the United States as a result of federal contracts for defense purposes, since the development and production of weapons is by far the largest single element of government spending.

Effects of Reduced Military Expenditures

The advanced weapons industry is also sufficiently large to have a substantial impact on the total economy as well. An illustration of this proposition is provided by events in 1957. In June 1957, a stretch-out (reduction in the rate of activity) for many weapons projects combined with a reduced rate of progress payments (partial payments made in advance of delivery to defense contractors engaged in the execution of a weapons project) had a significant impact on the national economy. Thus, defense contractors were required to finance privately a greater share of their work in progress. Both these actions were taken to maintain Department of Defense expenditures at the planned figure of $38 billion and to avoid additional government borrowing that would have necessitated an increase in the statutory limit on the federal debt.[3]

These steps resulted in defense contractors reducing both their work week and their labor force. In turn, this reduced consumer income and spending. In addition to these direct effects, these governmental actions created uncertainty in industry and among consumers which may have influenced both business and consumer spending.

While these actions did not precipitate the 1957 recession, it is generally agreed that they were contributing factors. In an article

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[3]See New York Times, June 2, June 23, and September 29, 1957, for a full discussion of these actions.

based on interviews with 165 business executives, including many whose firms had no defense contracts, Fortune criticized the stretchout and cutbacks in defense spending. It was noted that these measures were placed into effect just as the economy was slowing down. Economically, this was considered bad timing as well as having an adverse impact on the U.S. defense posture at the time the race for outer space was beginning.[4] Further evidence of this was presented by Professor Samuelson who listed among the contributing causes of the recession, "the drop in 1957 defense spending."[5]

This example substantiates the fact that the economic health of the weapons industry has a substantial impact on the stability of the economy of which it is such a major part. The location of the weapons system industry gives it a more vital role in this respect in many areas than its total size alone would indicate. Table 4 shows the distribution among the states for 1961 and 1962 defense procurement. These figures indicate that there is something for every state. Thus, the economic impact of fluctuations in spending for defense is diffused throughout the country and has a direct and immediate impact upon the economy of each locality.[6]

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[4]George B. Bookman, "How Top Businessmen View the Recession," Fortune, April 1958, p. 256.

[5]U.S. Joint Economic Committee, Subcommittee on Fiscal Policy, Hearings, Fiscal Policy Implications of the Current Economic Outlook, 85th Cong., 2d Sess (Washington, D.C., 1948), p. 175.

[6]Peck and Scherer, p. 106.

Table 4. Defense contract awards and estimated annual payrolls, by states, 1961 and 1962[a]

State	1961			1962		
	Contract awards[b]	Estimated annual payroll		Contract awards[b]	Estimated annual payroll	
		Military personnel[c]	Civilians[d]		Military personnel[c]	Civilians[d]
Total	24,305	6,057	5,592	27,800	6,948	5,828
Alabama	105	86	210	154	97	215
Alaska	92	124	45	63	129	45
Arizona	245	77	44	153	79	45
Arkansas	46	39	19	85	78	27
California	5,277	758	839	5,993	843	867
Colorado	466	117	84	565	159	89
Connecticut	1,018	22	15	1,213	18	16
Delaware	71	34	7	47	35	7
District of Columbia	150	69	176	182	69	172
Florida	493	235	140	645	246	145
Georgia	301	256	188	337	332	201
Hawaii	27	138	128	32	153	132
Idaho	14	23	3	26	25	3
Illinois	437	184	162	531	194	179
Indiana	353	34	62	637	47	70
Iowa	127	5	5	179	6	3
Kansas	539	138	32	394	158	34
Kentucky	46	159	71	44	200	75
Louisiana	139	77	34	244	161	45
Maine	97	67	11	80	62	10
Maryland	528	184	218	469	219	231
Massachusetts	1,072	146	158	1,310	150	161
Michigan	590	86	66	678	94	65
Minnesota	189	20	11	297	25	11
Mississippi	69	112	33	100	130	34
Missouri	338	102	83	546	133	88
Montana	95	38	7	31	38	7

Table 4 (continued)

State	1961			1962		
	Contract awards[b]	Estimated annual payroll		Contract awards[b]	Estimated annual payroll	
		Military personnel[c]	Civilians[d]		Military personnel[c]	Civilians[d]
Nebraska	51	73	26	53	81	26
Nevada	9	38	17	8	36	17
New Hampshire	105	36	62	59	40	62
New Jersey	950	144	164	1,063	181	161
New Mexico	64	88	68	61	94	69
New York	2,643	151	303	2,669	165	314
North Carolina	237	260	60	269	324	62
North Dakota	13	35	4	100	43	7
Ohio	1,004	83	218	1,063	88	232
Oklahoma	123	119	143	136	142	154
Oregon	28	20	22	46	21	21
Pennsylvania	804	55	399	952	57	417
Rhode Island	25	22	50	58	30	50
South Carolina	41	162	86	65	180	90
South Dakota	28	21	10	113	23	11
Tennessee	144	68	39	184	73	40
Texas	1,138	706	340	1,006	779	362
Utah	350	15	104	299	17	116
Vermont	16	2	1	16	2	1
Virginia	505	322	466	446	348	477
Washington	646	190	139	921	251	140
West Virginia	19	2	5	134	2	5
Wisconsin	222	18	11	259	18	13
Wyoming	24	15	4	23	17	4
Undistributed	2,192	82	---	2,762	67	---

[a]In millions of dollars. For years ending June 30. Data for contracts refer to awards made in fiscal year specified; expenditures relating to those awards may extend over several years.

[b]Awards of $10,000 or more for supplies, services, and construction. Figures reflect prime-contract awards and therefore do not show the effect of subcontracting on state distribution of defense work.

[c]For shore-based personnel only.

[d]Direct hire only.

Source: Department of Defense, Office of the Secretary. Reproduced from U.S. Bureau of the Census, Statistical Abstract of the United States, 1963 (Washington, D.C., 1963), p. 260.

Geographic Concentration of Spending for Weapons Systems

However, the geographic concentration of weapons spending is of greater importance than its dispersion--in terms of direct economic consequences. In fiscal year 1962, defense companies in 10 states received 65.7 percent of the prime contract awards, while firms in California alone received almost 24 percent.[7] Further, California firms are primarily concentrated in the Los Angeles-San Diego area, consisting of these two counties plus Imperial, Orange, Riverside, San Bernardino, Santa Barbara, and Ventura. The three defense industries (aircraft, electronics, and ordnance) account for 39 percent of the manufacturing employment in the Los Angeles area.[8] Add to this the businesses in other industries supporting the defense industry along with the proportion of goods and services purchased by defense employees and the effect is what is known as "California's Precarious One-Crop Economy."[9]

An estimate of direct defense employment in manufacturing in southern California indicated a total of 360,000. If these figures are comparable to total U.S. employment in missiles and aircraft of 977,900 in October 1959, as calculated by the U.S. Department of Labor, then southern California had at that time approximately one-third of all workers in the industry.[10]

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[7]U.S. Congress, Subcommittee on Defense Procurement of the Joint Economic Committee, Background Material on Economic Aspects of Military Procurement and Supply, 88th Cong., 1st Sess. (Washington, D.C., 1963), p.8.

[8]Maurice J. Gershenson, "Shifts in California's Industrial and Employment Composition," Monthly Labor Review, May 1959, p. 513.

[9]Seyom Brown, "Southern California's Precarious One-Crop Economy," The Reporter, January 7, 1960, p. 25.

[10]George A. Steiner, National Defense and Southern California (Los Angeles: Southern California Associates of the Committee for Economic Development, 1961), p. 84.

The consequences of such a concentration can have major economic impact on an area or community. The downward trend in several major weapons programs in 1961 and 1962 has created unemployment problems for many employees, plants, and communities. Examples of these are the B-52, B-58, BOMARC, HOUND DOG, SKYBOLT, ATLAS, BMEWS, and other programs.[11]

On the other hand, southern California has also experienced problems with the explosive growth of defense installations. Lompoc grew in three years from a community of approximately 5,250 to almost 15,000 because of the establishment of Vandenberg Air Force Base and the Point Arguello Naval Missile Facility.[12]

The city of San Diego is a prime example of what may happen to an area with a heavy concentration of defense spending, when many of these contracts are withdrawn. In 1961, aircraft missile employment and government wages made up 44 percent of the San Diego civilian payroll.[13] During World War II, San Diego became one of the nation's largest aircraft producers, as well as being the site of the San Diego Naval Base. Its population rose from 289,348 to 556,808 in 1950 and by 1960 it had soared to 1,033,011. It was considered the fastest-growing major city in the United States. As the years went by, the aircraft industry edged into the missile industry, but stayed mainly with aircraft production. In 1950, the industry grossed $104,500,000; by 1960 the yearly figure was

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[11]U.S. Congress, Subcommittee on Defense Procurement of the Joint Economic Committee, Hearings, Impact of Military Supply and Service Activities on the Economy, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 60.

[12]Steiner, p. 107.

[13]"How San Diego Got Trapped," Business Week, December 8, 1962, p. 127

over $1 billion. Then the Air Force stopped buying Convair's F-102 and F-106 airplanes. In 1961, San Diego's industry took in a bare $215 million on planes and missiles.[14]

As a result of the shift from aircraft to missiles, employment dropped steadily and San Diego's unemployment grew to 8.8 percent and was likely to grow higher, for Convair's liquid-fueled Atlas was gradually being phased out in favor of the solid-fueled Minuteman.[15]

Concentration of Research and Development

Fifty-eight percent of all monies spent on missiles and 25 percent of all expenditures for electronics in fiscal year 1961 were for research, development, test, and evaluation work. There has been a strong tendency toward concentration of such contracts in California and in the coastal strip from Boston, Massachusets, to Washington, D.C. Also benefiting have been certain Mountain and Southern states.[16]

Department of Defense contracts awarded for research and development in fiscal year 1962 totalled over $6 billion, which was almost one-fourth of all prime contract awards during that year. Further, the awards for the procurement of research and development is in a strongly rising trend.[17]

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[14]"Bust Town?" Newsweek, August 17, 1962, p. 20.

[15]Ibid.

[16]U.S. Senate Select Committee on Small Business, Impact of Defense Spending on Labor Surplus Areas--1962, 87th Cong., 2nd Sess. (Washington, D.C., 1962), p. 171.

[17]U.S. Congress, Subcommittee on Defense Procurement of the Joint Economic Committee, Background Material on Economic Aspects of Military Procurement and Supply, 88th Cong., 1st Sess., (Washington, D.C., 1962), p. 41.

These contracts are more closely concentrated in a few states than the remaining three-fourths of defense procurement. In fiscal year 1962, these were the 12 leading states performing 88.5 percent of all the research, development test, and evaluation work.[18]

	Percent		Percent
California	39.2	Colorado	3.75
New York	10.87	Florida	3.78
Washington	8.06	Maryland	3.12
Massachusetts	5.92	Ohio	2.17
New Jersey	4.80	Utah	1.95
Pennsylvania	3.86	Connecticut	1.06

The remaining 11.5 percent of the total research effort was contracted with business and non-profit firms in the remaining 38 states. It is noteworthy that California and the Eastern Seaboard states, between them performed almost three-fourths of all military research and development during fiscal year 1962. This is highly significant, because a firm which has conducted or managed the research, design, development, and test work on a new weapon system or a major component thereof, and has assembled the engineering talent and experience for this purpose, obviously has a great advantage in competing for the follow-on production contracts and for new developmental contracts as well. It is logical, then, that production contracts for newly developed items, figuring heavily in future federal procurement, have a tendency to be placed where the research, development, test, and evaluation effort has been centered. About these awards: "Many people believe them to be the seed corn variety, which later leads to even larger production contracts."[20]

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[18]U.S. Senate, Select Committee on Small Business, Thirteenth Annual Report, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 40.

[19]Thirteenth Annual Report, p. 71.

[20]Background Material on Economic Aspects of Military Procurement and Supply, p. 40.

The Procurement Mix of the Weapons Industry

There is no one clearly identifiable product which is produced by the weapons industry. These products are partly defined by their use, which may be for the potential destruction of an enemy or for defense of the country against destruction by such an enemy and also partly by their advanced technical characteristics. The relative importance of various types of weapons meeting these requirements has changed radically in the past 20 years.[21]

Missiles have increased greatly in importance--spending for missiles has risen from 0.5 percent in 1953 to about 33.6 percent of all hard goods purchased for defense in 1961.[22]

Expenditures for aircraft have remained relatively constant between 1953 and 1961. Aircraft spending was at 31.5 percent of fiscal year 1953 deliveries, and at 28.2 percent of the total fiscal year 1961 procurement.[23]

It is in spending for ships and ordnance where there has been a great decline. Expenditures for ships were 26.2 percent of the hardware bill during World War II, and dropped to 6.8 percent in fiscal year 1953 and was 7.8 percent in fiscal year 1961.[24]

Ordnance (items such as tanks, other vehicles, weapons and ammunition) plus production, construction, and other commercial types of

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[21]Peck and Scherer, p. 107.

[22]U.S. Senate, Subcommittee on Retailing, Distribution, and Marketing Practices, Report to the Select Committee on Small Business, Impact of Defense Spending on Labor-Surplus Areas, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 5.

[23]Ibid., p. 169.

[24]Ibid.

equipment and hardware constituted about 50 percent of the military hard goods bought in fiscal year 1953. By fiscal year 1961, these were only 12.4 percent of the total prime contract awards. In eight years, they had fallen from one-half to one-eighth of the total hard goods buy.[25]

Significantly, expenditures for electronics in current weapons systems has increased tremendously--both in aircraft and in missiles. Authoritative estimates indicate that for fiscal year 1964, the electronics bill will be 30 percent of the research and development budget, 25 percent of the aircraft budget, and 35 percent of the missile budget and $1.5 billion for "pure" electronics not associated with aircraft and missiles. These expenditures will approximate $6.6 billion in fiscal year 1964.[26] Coupled with space expenditures of $2.3 billion for electronics (about $800 million for military purposes) the total is about $9 billion for electronics.[27]

The increase in expenditures for missiles and electronics and the decline in the spending for ordnance, ships, and to a limited extent for aircraft, has had a major impact on a large section of the economy. These changes in defense procurement have also caused some major geographic consequences.

Geographic Shifts of Weapons Procurement

The changes in the weapons systems product mix has caused major changes in the location of those industries providing weapons and weapons

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[25] Ibid.

[26] "Military Electronics Will Level Off In Fiscal 1964," Electronics, January 25, 1964, p. 18.

[27] Ibid.

products to the government. The greatest geographical adjustments may be found in the heavy losses of the East North Central and Middle Atlantic areas and in the large gains of the West Coast and Mountain states. The Mountain and Pacific states which had 13.5 percent of prime World War II contract awards, increased this share to 18.6 percent during the Korean conflict and to 32.6 percent in fiscal year 1961. The large increase in electronics and missile procurement are definitely related to these statistics.[28]

On the opposite side of the coin, we find that the states of Illinois, Ohio, Indiana, and Wisconsin, combined, were awarded 21.9 percent of the total defense contracts in World War II, 17.8 percent during the Korean conflict, and only 9.1 percent in fiscal year 1961. The East North Central area defense contract awards dropped from $8.7 billion during Korea to $2.6 billion in 1961. The loss of $6.1 billion per year in defense contracts can have severe economic impact and can mean hundreds of thousands of jobs. It is no surprise, then, that many communities in these states have encountered recurrent unemployment problems. During the World War II and Korean conflicts, these states contributed heavily to the production of wheeled vehicles, weapons, ammunition, and equipment items which made up a large portion of the defense procurement bill, but which now form a relatively smaller share of defense requirements.[29]

The Middle Atlantic states, New York, Pennsylvania, and New Jersey had a smaller share of defense awards in 1961 than during Korea, but the

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[28] Impact of Defense Spending on Labor Surplus Areas--1962, p. 169.

[29] Ibid., p. 171.

losses were relatively less serious than for the Midwest. The gains in electronics and missiles for the plants of these states, balanced out against losses in the more traditional fields of procurement, particularly in the western section of New York.[30]

The rapid rise in expenditures for missiles and electronics is also related to the higher share in fiscal year 1961 awards, compared with the Korean period to firms in Massachusetts, Texas, and Florida, as well as the plants in California and Colorado.[31]

The changing geography of American industry has had significant impact on the employment-unemployment picture in the United States. Since 1947, eight states had an employment growth which was double the national average. These were Arizona, California, Colorado, Florida, Nevada, New Mexico, Texas, and Utah. And one of the most dramatic indications of this changing geography is that one out of every six jobs in the United States is located in just three states--California, Florida, and Texas. However, large industrial states like Wisconsin, Michigan, Illinois, Indiana, and Ohio increased their employment by less than the national average.[32]

Preparation for Reduced or Shifting Defense Spending

The relaxed tensions since the Cuban crisis, along with the nuclear test ban have brought hopes that peace and disarmament were possible to achieve over an extended period. In recognition of the possible economic

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[30] Ibid.

[31] Ibid.

[32] Ibid., p. 26.

consequences, the President ordered the formation of a high-level government committee to help him cope with the impact of possible arms reductions and shifts in defense spending. The President feared that military spending changes could weaken the economy. The impact of a large reduction from the $1 billion a week expenditures for defense, which was about half of the entire $98 billion budget for fiscal year 1964, could be highly significant.[33] The President stated in a memorandum:

> Federal outlays for defense are of such magnitude that they inevitably have major economic significance. In certain regions of the nation and in certain communities, they provide a significant share of total employment income. It is therefore important that we improve our knowledge of the economic impacts of such spending, so appropriate action can be taken in cooperation with state and local governments, private industry, and labor to minimize potential disturbances which may arise from changes in the level and patterns of defense outlays.[34]

The Deputy Assistant Secretary of Defense for Arms Control expected visible progress toward an East-West Arms Control agreement in the ensuing year, and he urged defense contractors to seek new markets as insurance against reduced military expenditures. He indicated that the demand for equipment for arms control inspection could not be expected to make up for the amount of defense procurement reductions if an arms agreement was reached.[35]

There is a difference of opinion on how well the economy would bear up under a major reduction in arms outlays. Some leading government officials are on record as saying an adjustment could be relatively smooth

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[33] New York Times, December 22, 1963, p. 1.

[34] Ibid.

[35] New York Times, December 27, 1963, p. 3.

with proper planning.[36] The Deputy Secretary of Defense stated:

> There is no reason that the economic impact of defense programs, whether stemming from major budget shifts either up or down, or from the shifting pattern of procurement within a relatively limited budget--cannot be accommodated without serious disruption or distortion of our overall economic position.[37]

He stated further that he hoped for a decline in defense spending, but that even if there was an increase in military spending, "there would still be continual changes in the pattern of procurement . . . there would still be shifts in installations and base closings, there would still be program cancellations and completions . . . ."[38] These changes would have consequences for the geographical areas in which they occurred.

Some private groups are less optimistic about the ability of the economy to withstand the impact of a severe drop in arms expenditures without causing grave trouble. The Stanford Research Institute would expect a monumental problem if there should occur any large shift in either the amount or the pattern of defense spending.[39]

Some contractors are particularly vulnerable to reductions since they rely almost completely on government business. Examples of such companies are Republic Aviation, McDonnell, Grumman, Lockheed, Avco, and North American. By contrast, other top defense contractors are broadly diversified and could withstand the impact of a big cut in the defense budget without too much strain. Companies such as General

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[36]"Shifts in Defense Business," Financial World, January 1964, p. 3.

[37]Katherine Johnsen, "Effort Urged to Ease Effect of DOD Shifts," Aviation Week and Space Technology, November 11, 1963, p. 31.

[38]Ibid.

[39]"Shifts in Defense Business," p. 3.

General Electric, whose $1 billion worth of business with the government accounts for only 20 percent of its total yearly volume and American Telephone and Telegraph whose one-half billion dollars worth of government business accounts for only 3 percent of its yearly volume, would have no great difficulties. However, the average defense contractor does not enjoy such diverisification, and a large reduction in defense business could have serious economic consequences on such a firm and the community in which it is located.[40]

A Senate Subcommittee on manpower and employment as well as an inter-agency group under the President's Council of Economic Advisors began to study the effect of the military program on the over-all economic growth, and the adaptability of the defense industry to shifts in military requirements or disarmament. These groups considered the cutbacks resulting from changing military requirements or from possible disarmament as the same basic problem. Cutbacks hitting hard at one defense firm and one community are being called "little disarmaments." "To the people involved, these are the same as disarmament."[41]

These committees were to establish the organizational machinery and policies to meet the disruptions of these "little disarmaments." By so doing, there would be preparation to adjust smoothly to changes that might be required by any general disarmament step.[42]

The size of the weapons industry, its widespread dispersion

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[40] Ibid.

[41] Katherine Johnsen, "Economic Impact of Defense Shifts Eyed," Aviation Week and Space Technology, September 30, 1963, p. 28. Statement by Archibald S. Alexander, Chief of the Economic Bureau of the Arms Control and Disarmament Agency.

[42] Ibid.

throughout the states, along with its heavy concentration in specific areas and its crucial importance to these areas, means that changes to the weapons acquisition process have widespread economic consequences. As a result, there will also be some political pressures upon weapons development and production decisions, for there is too much at stake in the purchase of modern weapons to allow this to be a private affair between the services and their contractors.[43]

Political Implications of Defense Spending

The distribution and award of government contracts are of great concern to those who are elected to look after the interests of the states, districts, municipalities, etc. Since the development and production of weapons is by far the largest single element of government spending, political variables are obviously reflected in the weapons acquisition equation. Political pressures are apt to arise in connection with the selection of firms to conduct new weapons programs and with the cancellation of going programs.[44]

These pressures are also related to the geographic shifts of weapons procurement previously discussed. Senator Javits of New York introduced a bill in 1959 that required procuring agencies to consider "the strategic and economic desirability of allocating purchases to different geographic areas of the Nation."[45] This action was viewed by the West Coast as an attempt by Easterners to reverse the rising trend of West Coast domination of the weapons systems business. In order to

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[43]Peck and Scherer, p. 107.

[44]Ibid., p.96.

[45]U.S. Senate, Subcommittee of the Committee on Armed Services, Military Procurement, 86th Cong., 1st Sess. (Washington, D.C., 1959), pp. 22-24. From Section 2, C, 111 of the Bill.

present opposition to this bill, the Los Angeles Chamber of Commerce organized an emergency industrial task force of prominent businessmen and "the task force called Professor Gerhard Rostvold of Pomona College, to prepare the California case against the conspiracy of the Easterners to 'raid' the Pacific Coast's defense cluster."[46]

In the East, feelings also ran strong. Senator Javits stated:

> To many of us in the East, the so-called missile gap has been translated into the defense order gap. Many New Yorkers apply this term to the steady loss of defense contracts in our State, while there has been a steady increase in prime defense missile contracts placed in other parts of the country, particularly with firms on the West Coast.[47]

This sectional rivalry has continued through the years.

In a press release, Governor Edmund G. Brown of California said that his state gets a large share of national defense contracts because it earns them, not because the federal government is partial to the state. In a telegram to Senator Javits, the Governor objects to Javits' criticism of the Defense Department's contract award policy and his inference of favoritism to California. He told the New York Republican that California gets 24.6 percent of defense contracts because it is able to provide the research facilities and scientists to do 41.3 percent of all defense research and development being done in the country.[48]

Following is the text of the Governor's telegram:

> I must object to the error and injustice of your charges against the national administration's policies for the awarding of defense contracts and the inference you draw of favoritism

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[46]Brown, p. 28.

[47]U.S. Congress, Subcommittee on Defense Procurement of the Joint Economic Committee, Hearings, Impact of Defense Procurement, 86th Cong., 2nd Sess. (Washington, D.C., 1960), p. 24.

[48]Press Release 561, Office of the Governor of California, July 26, 1962.

> toward California. According to a recent Defense Department study of contract awards with which you should be familiar, California has earned her 24.6 per cent share of all defense contract awards by providing the research facilities and skilled scientists who do 41.6 per cent of this country's research in the defense fields, especially in the rapidly expanding aerospace industry. The people of California have invested heavily to develop and support the finest system of higher education in the country. This provides the defense industries many of the facilities they must have for research and, more important, the trained scientists and technicians they require. I am sympathetic with your concern for New York's serious unemployment problems and I know the administration is, too. However, it is not need for defense contracts but the ability to fulfill them which must dictate the Defense Department's contract award policy. I respectfully suggest that New York would be in a better position to compete with California in the defense field if it were to give the attention to public higher education which increasingly has been given top priority in our state.[49]

Despite these rivalries and accusations, it appears that politics have little bearing in the award of weapons systems contracts.

> Yet, from our own case studies, we would say that at least the direct effect of politics in weapon acquisition processes tends to be exaggerated. We discovered only a few decisions in which a possible direct political influence may have played a role, and even here the political factor was so intermixed with other issues that it is difficult to discern its importance in shaping the outcome.[50]

Concentration of Military Contracts

Military contracts, in addition to being concentrated in specific geographic areas, are also concentrated in the hands of a relatively small number of large companies. Table 5 shows that the first 100 companies, in terms of contract volume, during the fiscal years 1958 through 1962, received from 74.2 percent to 72.3 percent of the United States total

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[49] Ibid.

[50] Peck and Scherer, p. 114.

Table 5. Percent of defense contract awards to first 100 companies

Companies	Percent of U. S. total Fiscal year				
	1958	1959	1960	1961	1962
1st	9.8	7.2	6.0	6.5	5.6
2nd	6.4	5.2	5.1	5.2	4.7
3rd	3.6	4.5	4.8	5.2	4.4
4th	3.5	4.1	4.6	4.1	4.0
5th	3.0	4.0	4.3	3.8	3.8
1 to 5	26.3	25.0	24.8	24.8	22.5
6 to 10	12.4	12.0	11.3	11.8	11.1
11 to 25	19.1	17.6	17.4	18.2	17.2
1 to 25	57.8	54.6	53.5	54.8	50.8
26 to 50	9.1	10.7	11.3	11.0	12.6
51 to 75	4.8	5.5	5.4	5.5	6.0
76 to 100	2.5	3.0	3.2	2.9	2.9
1 to 100	74.2	73.8	73.4	74.2	72.3

Source: U.S. Department of Defense, 100 Companies and their Subsidiary Corporations Listed According to Net Values of Military Prime Contract Awards, n.d. (mimeographed)

dollars of military contracts of $10,000 or more. Noteworthy is the fact that the first five companies in this group received 26.3 percent to 22.5 percent of the total, while the first 25 companies received from 57.8 percent to 50.8 percent of the total. These statistics reveal a tremendous concentration of economic power. The magnitude of this power can readily be seen from the totals of fiscal years 1961 and 1962. In fiscal year 1962, the 72.3 percent volume of military expenditures with the first 100 companies represented approximately $18.5 billion

out of a total of $25.5 billion, and in 1961 the 74.2 percent represented about $16.8 billion out of a total of $22.7 billion.[51]

Congress has shown concern over this concentration of dollar outlays for military contracts. Some steps to encourage more widespread distribution of military outlays have been taken so that increased participation by small business in government defense contracts may be achieved. The next chapter will be devoted to a discussion of the role of small business in weapons systems procurement.

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[51] Background Material on Economic Aspects of Military Procurement and Supply, pp. 13, 18.

CHAPTER IV

SMALL BUSINESS AND DEFENSE PROCUREMENT

Definition of Small Business

What makes a business "small"--and thus eligible for special treatment--depends on administrative judgment using criteria such as number of employees, sales volume, and type of activity. The dividing line between "medium" and "small" has been fuzzy.

Small business has been generally defined for purposes of government procurement as a concern employing no more than 500 persons. Recent changes have modified this definition so that the number of employees may be as high as a thousand in certain businesses and industries, depending on their nature. Further, some industries are now classified as either little or big business, based on annual dollar sales. As an example, in the construction industry, the average annual sales of the concern and its affiliates must not exceed $7.5 million a concern.[1] The following general definition is quoted:

> A small-business concern shall be deemed to be one which is independently owned and operated and which is not dominant in its field of operation. In addition to the foregoing criteria, the Administrator, in making a detailed definition, may use these criteria among others: Number of employees and dollar volume of business. Where the number of employees is used as one of the criteria in making such definition for any of the purposes of this Act, the maximum number of employees which a small-business concern may have under the definition shall vary from industry to industry to the extent

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[1] Armed Service Procurement Regulation 1-701.4 (Washington, D.C., 1964), p. 142.

> necessary to reflect differing characteristics of such industries and to take proper account of other relevant factors.[2]

Interest in Small Business

The Small Business Act of 1953 (Public Law 163, 83rd Congress, 1st Session) created the Small Business Administration. The following policy of the Congress with regard to small business is found within section 202 of that act:

> It is the declared policy of the Congress that the Government should aid, assist, and protect insofar as possible the interests of small business concerns in order to preserve free competitive enterprise, to insure that a fair proportion of the total purchases and contracts for supplies and services for the government be placed with small business enterprises, and to maintain and strengthen the over-all economy of the nation.[3]

The purchasing power of the federal government in regard to small business is being used as an implementing instrument of economic policy. Inasmuch as there has been concern over the placement of a "fair share" of military procurement with small business, the government has adopted a deliberate policy of providing a greater share of such procurement to foster the welfare of the small business community.

The interest in promoting the welfare of small business has long been the policy of Congress. However, in the past several years much emphasis has been placed on this area by the Executive Branch. President Kennedy made the following statement during his press conference on March 15, 1961:

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[2]U.S. Senate, Select Committee on Small Business, Small Business Act, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 1.

[3]U.S. Senate, Select Committee on Small Business, Report of Small Business Participation in Government Procurement, 85th Cong., 1st Sess. (Washington, D.C., 1957), p. 1.

> First, the Secretaries of the military departments have been instructed by the Deputy Secretary of Defense to take steps to provide a greater percentage of defense contracts for small business. Specifically the military departments have been asked to set a goal increasing individually in fiscal year 1962, small business participation by ten percent over the year for fiscal 1960. Contracts for small business in fiscal year 1960 amounted to $3,444 million or 16 percent. We are going to try to increse that by at least 10 percent. In addition we are going to provide an increase for small business participation in research and development contracts. During that year this category of contracting accounted for $180 million, or 3.4 percent of the total. In addition, we are asking the Department of Defense to examine how additional contracts can be steered into distressed areas. At the present time we are not doing as much of that as I hope we can in the future.[4]

As a result of this interest by the Chief Executive and the goal he established, the Secretary and Deputy Secretary of Defense, along with the Secretaries of the Army, Navy, and the Air Force maintained a continuous followup on this matter during the following year and issued numerous memorandums to the military departments stressing the importance of increasing the volume of contract awards to small business concerns

Further, the Department of Defense established a program called "Operation Booster" in fiscal year 1962, under which every principal procurement organization was assigned an improvement quota against which their performance was measured monthly.[5]

The results were that for the first time in five years a downward trend in the percentage of awards to small business was reversed as indicated in Table 6. The percentage of prime contract awards[6] increased

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[4]New York Times, March 16, 1961, p. 20.

[5]U.S. Senate, Select Committee on Small Business, The Role of Small Business in Government Procurement--1962-1963, 87th Cong., 2nd Sess., 1962 (Washington, D.C., 1962), p. 5.

[6]A prime contract award is a direct contract award from the Department of Defense for specified goods or services to a business concern. The recipient of the award is a prime contractor.

Table 6. Awards by type of contractor by fiscal year (amounts in millions)

Type of Contractor	FY 1951	FY 1952	FY 1953	FY 1954	FY 1955	FY 1956	FY 1957	FY 1958	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963
TOTAL	$22,582	$31,559	$31,218	$31,272	$29,392	$31,474	$32,455	$30,457	$32,238	$32,677	$29,[illegible]	$31,[illegible]	$[illegible]
Army	15,676	26,191	7,406	7,115	7,827	4,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Navy	6,759	16,323	7,907	4,745	4,559	6,246	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Air Force	8,918	12,545	14,437	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Defense Supply Agency b/	---	---	---	---	---	---	---	---	---	---	---	[illegible]	[illegible]
Other Defense Agencies c/	---	---	---	---	---	---	---	---	---	---	---	---	[illegible]
INTRAGOVERNMENTAL	[illegible]	768	572	426	341	434	462	331	758	781	881	1,156	347
Army	[illegible]	372	333	241	239	182	178	203	305	292	303	479	75
Navy	[illegible]	264	143	81	164	96	79	100	141	155	189	216	133
Air Force	[illegible]	132	114	95	138	172	205	226	309	370	389	471	140
Defense Supply Agency b/	---	---	---	---	---	---	---	---	---	---	---	82	16
Other Defense Agencies c/	---	---	---	---	---	---	---	---	---	---	---	---	5
FOR WORK OUTSIDE U. S.	758	1,119	1,418	1,411	1,111	1,406	1,602	1,444	1,410	1,226	1,280	1,494	1,271
Army	395	1,025	2,012	960	697	899	729	740	654	574	552	746	526
Navy	3	59	481	206	215	502	551	530	491	504	433	403	146
Air Force	73	235	921	285	199	205	322	174	255	225	265	275	269
Defense Supply Agency b/	---	---	---	---	---	---	---	---	---	---	---	70	328
Other Defense Agencies c/	---	---	---	---	---	---	---	---	---	---	---	---	2
EDUCATIONAL & NON-PROFIT INSTITUTIONS d/	NA	NA	NA	NA	NA	NA	261	335	400	380	438	427	618
Army							103	198	140	111	96	65	86
Navy							65	90	98	126	140	147	177
Air Force							93	107	162	143	236	285	316
Defense Supply Agency b/							---	---	---	---	---	*	*
Other Defense Agencies c/							---	---	---	---	---	---	39
BUSINESS FIRMS FOR WORK IN THE U. S. (SUB-TOTAL)	20,823	29,439	27,809	29,448	26,930	29,750	29,133	28,327	29,744	29,308	26,998	29,147	27,143
Army	14,631	25,794	7,077	5,946	6,302	3,831	4,446	4,952	4,957	4,911	5,598	6,403	5,681
Navy	7,458	10,600	7,283	4,062	4,280	5,642	5,894	6,271	6,941	6,746	7,174	8,001	7,803
Air Force	8,740	12,178	13,462	5,440	6,348	8,277	8,793	10,704	10,846	9,645	10,526	10,738	11,189
Defense Supply Agency b/	---	---	---	---	---	---	---	---	---	---	---	1,005	2,326
Other Defense Agencies c/	---	---	---	---	---	---	---	---	---	---	---	---	144
Small Business Firms	5,436	7,066	4,608	2,902	1,814	1,475	1,783	1,789	1,753	1,440	1,657	1,622	1,301
Army	1,322	1,960	2,584	1,488	1,894	1,675	1,324	1,801	1,743	1,528	1,568	1,761	1,151
Navy	1,213	2,409	1,415	856	504	1,114	1,231	1,172	1,223	1,348	1,112	1,371	1,133
Air Force	911	697	609	558	576	586	725	756	920	864	977	1,026	975
Defense Supply Agency b/	---	---	---	---	---	---	---	---	---	---	---	64	43
Other Defense Agencies c/	---	---	---	---	---	---	---	---	---	---	---	---	6
SMALL BUSINESS PERCENT OF BUSINESS FIRMS	26.1%	17.0%	16.6%	25.1%	21.5%	19.6%	19.8%	17.1%	16.6%	16.1%	15.9%	17.7%	15.8% e/
Army	29.5	21.2	36.5	76.5	42.6	43.7	41.1	37.1	35.1	31.1	29.6	27.5	20.8
Navy	16.3	22.7	19.4	21.1	18.8	19.7	20.9	18.7	18.2	19.5	15.5	17.1	19.3
Air Force	9.9	5.7	4.5	10.3	9.1	8.3	8.2	7.1	8.5	9.0	9.3	9.6	8.7
Defense Supply Agency b/	---	---	---	---	---	---	---	---	---	---	---	6.2	10.2
Other Defense Agencies c/	---	---	---	---	---	---	---	---	---	---	---	---	4.2

a/ For definitions and coverage, see Notes on Coverage.
b/ Includes awards since 1 January 1962, when procurement responsibility for certain common supplies was transferred from the military departments.
c/ Includes procurement by Office of the Secretary of Defense, Office of Civil Defense and the Defense Commercial Communications Office.
d/ Prior to fiscal year 1957, data on Educational and Non-Profit Institutions were included in the data for "Business Firms for Work in the U. S."
e/ Not comparable with prior years because of a change in reporting coverage. If reported on a comparable basis, the ratio would be 16.5 percent.

NA - Not available.
* Less than $500,000.

Source: U.S. Department of Defense, Military Prime Contract Awards and Subcontract Payments, July 1963 - March 1964 (Washington, D.C., 1964), p. 12.

from 16.1 percent in fiscal year 1960 and 15.9 percent in fiscal year 1961 to 17.7 percent in fiscal year 1962. More remarkable, however, was the increase in the dollar volume to small business. There was an increase from $3.4 billion in fiscal year 1960 to $4.6 billion in fiscal year 1962. This was a 35 percent increase. However, the decrease of prime contract awards from $4.6 billion or 17.7 percent of the total contract awards in fiscal year 1962 to $4.3 billion or 15.8 percent in fiscal year 1963 resulted in much Congressional criticism.

However, these statistics reveal only one source of defense dollars to small business concerns. To ascertain the full share of the dollars received by small business, it will be necessary to examine the situation related to the amount of subcontracting[7] dollars going to small business from other prime contractors along with the amounts they receive on prime contract awards.

A "Fair Share" for Small Business

In 1961 the Select Committee on Small Business of the United States Senate stated in its opening paragraph to Chapter II, "Government Procurement" of their "Annual Report":

> With few changes, save for figures in dollars and percentages, the introduction to this chapter could easily be a duplicate of the chapter on procurement in last year's annual report. Last year at this time, your committee expressed concern over the downward spiral of defense contracts being awarded to smaller firms, and commended the Air Force for its small but significant increase. Statistics for fiscal year 1960 recorded the same dirge. For the sixth straight year, the percentage of defense awards going to small firms showed

[7]A subcontract is a contract awarded by a prime contractor to another concern.

> a decline, from 25.3 percent in 1954 to 16.1 percent the past year.[8]

The Committee in the same report, goes on further to state:

> Nowhere is it more pointedly driven home that small business is not receiving a fair share than when one considers that just three major prime contractors received a greater percentage of defense contract dollars than did all the thousands of small business firms in the United States combined. Your committee cannot visualize the necessity for such intense centralization of our nation's defense effort, even allowing for all the technological factors modern weaponry has introduced into the procurement machinery.[9]

Further concern is evidenced by the following:

> The joint failure of the Department of Defense and the Small Business Administration to halt the decline and correspondingly, to increase the share of small business in the awarding of military prime contracts has brought about a situation which should no longer be tolerated.[10]

Research in this area reveals numerous references to a "fair share" of defense dollars for small business, but a clear concise definition of what constitutes a "fair" percentage of the total dollar outlay for defense purposes cannot be found. Mr. Maurice L. Johnson stated that, "I have yet to see a declaration by any agency, or Congressional Committee that specifically states the meaning of a 'fair share'."[11] The government has been remarkably silent on defining the "fair share." However, the Department of Defense has established a target for the amount of dollar outlays to small business.

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[8]U.S. Senate Select Committee on Small Business, Eleventh Annual Report, 87th Cong., 1st Sess. (Washington, D.C., 1961), p. 19.

[9]Ibid.

[10]Ibid., p. 5.

[11]Interview with Maurice L. Johnson, Executive for Small Business, Directorate of Procurement and Production, Headquarters, Air Force Logistics Command, United States Air Force, May 25, 1964.

The Department of Defense established new goals in early 1963, and these were to raise the value of prime and subcontract awards to small business in the following three years so that by the end of fiscal year 1965, small business will receive more than $10 billion in defense awards, or approximately 33 percent of the defense procurement budget. The fiscal year 1963 goal was to increase prime contract awards from $200 to $300 million over fiscal year 1962 and subcontract awards by $300 million. The 1964 and 1965 fiscal year goals are to add $300 million each year to both the total value of prime contract and subcontract awards to small business.[12] Whether these goals are attained remains to be seen, and once attained, whether they will be considered satisfactory by Congress is also problematical.

The Small Business Share of the Defense Dollar

In fiscal year 1963, small business firms obtained a total of $8.8 billion in defense contracts which consisted of $4.6 billion in prime contract awards and $4.2 billion in subcontract payments from large defense subcontractors. This total was the equivalent of 31.6 percent of all prime contract awards to business firms in the United States.[13]

As reflected in Table 6 the Army and the Defense Supply Agency award a greater percentage of their total procurement dollars to small business than do either the Navy or the Air Force. The Air Force

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[12]U.S. Department of Defense, Small Business Report, Small Business Objectives for Fiscal Year 1963 and Subsequent years (Washington, D.C., 1963), p. 8.

[13]U.S. Senate, Conference Relating to Small Business Participation in Government Procurement--1963, 88th Cong., 1st Sess. (Washington, D.C., 1964), p. 2.

traditionally has awarded a lower percentage of their procurement dollars to small business concerns because their purchases are dominated by aircraft and missiles in which small business plays a minor role. On the other hand, small business has done relatively well with the Army because of their requirements for a larger proportion of subsistence, textiles, and automotive items in which small companies play a major role. This is also reflected by types of items in Table 7 which show small business procurement by major programs.

As shown in Table 7, in fiscal year 1963, small business received 51.3 percent of all contract awards for subsistence items and 62.5 percent of all awards for textiles, clothing, and equipage. The recently activated Defense Supply Agency which procures much of the combined requirements of items such as electronics supplies, subsistence, clothing, etc., for the Army, Navy, and the Air Force is in a better position to award a high percentage of their total contract dollars to small companies, because most of their purchases are items in which small business has a major stake. For the fiscal years of 1962 and 1963, the Defense Supply Agency awards to small business concerns were 46.2 percent and 40.5 percent of all prime contract dollars, respectively, as against 9.6 percent and 8.7 percent, respectively, by the Air Force (Table 3).

The long term trend in military procurement, including the small business percentage, is shown in Table 6 and Figure 1. After the close of hostilities in Korea, there was a sharp cutback in military procurement of heavy equipment (fiscal year 1954), and a correspondingly sharp increase in the percentage going to small business firms. The international situation and the increasing emphasis on modern expensive

Table 7. Awards by procurement program, by fiscal year (net value $000)

MAJOR PROGRAM	FY 1957	FY 1958	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	FY '57	FY '58	FY '59	FY '60	FY '61	FY '62	FY '63
TOTAL b/	$21,457,482	$24,196,917	$25,312,065	$23,688,533	$23,584,390	$25,254,502	$29,378,720							
INTRAGOVERNMENTAL	462,354	531,179	758,34	720,572	866,940	1,159,481	346,516							
FOR WORK OUTSIDE U. S.	1,601,624	1,442,382	1,410,034	1,226,316	1,279,713	1,454,099	1,826,639							
EDUCATIONAL AND NON-PROFIT INSTITUTIONS	26,113	394,376	339,446	375,896	438,170	497,465	617,846			Percent of Total				
ALL BUSINESS FIRMS FOR WORK IN THE U. S. (SUB-TOTAL)	19,132,697	21,328,74	22,744,245	21,301,446	22,991,547	26,147,463	27,143,517	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MAJOR HARD GOODS (Sub-Total)	10,771,239	13,595,607	15,239,876	14,868,194	16,612,669	18,760,409	19,043,166	56.3	63.7	67.8	69.5	72.3	71.7	70.2
Aircraft	5,028,833	7,411,134	8,487,043	4,788,349	4,935,898	5,103,588	5,476,639	26.2	33.9	28.5	22.5	21.5	19.5	20.2
Missile Systems	1,363,711	2,230,964	4,498,340	4,963,736	5,863,871	6,630,093	6,688,656	9.8	13.0	19.7	23.4	25.6	25.6	24.6
Ships	927,467	650,199	1,094,793	1,009,671	1,365,539	1,475,039	1,682,780	4.8	3.0	4.8	4.7	6.0	5.6	6.2
Tank-Automotive	364,291	495,028	351,656	403,847	576,594	1,044,263	1,038,066	1.9	2.3	1.5	1.9	2.5	4.0	3.8
Weapons	274,163	212,146	158,937	126,755	142,771	200,171	214,056	1.4	1.0	0.8	0.6	0.6	0.8	0.8
Ammunition	434,080	290,039	356,436	475,847	411,251	920,786	886,081	2.3	1.4	1.6	2.2	2.4	3.5	3.3
Electronics and Communications Equipment	1,878,696	1,987,827	2,474,174	3,480,189	3,114,05	3,386,467	3,456,888	9.9	9.1	10.9	14.2	13.7	12.7	11.3
SERVICES	2,770,544	2,719,916	1,871,477	1,321,234	1,092,169	1,089,740	1,503,931	14.5	12.4	8.2	6.2	4.7	4.2	5.5
ALL OTHER (Sub-Total)	5,590,914	5,211,217	5,425,876	5,172,018	5,285,732	6,297,314	6,596,426	29.2	23.9	24.0	24.3	23.0	24.1	24.3
Subsistence	532,305	462,269	490,851	468,34	466,92	574,935	585,572	2.7	2.1	2.2	2.2	2.0	2.2	2.2
Textiles, Clothing & Equipage	330,842	246,374	177,654	176,541	263,54	407,253	295,767	1.7	1.1	0.8	0.8	1.1	1.6	0.9
Fuels & Lubricants	952,059	869,909	961,382	856,365	815,95	862,877	877,263	5.0	4.0	4.3	4.0	3.6	3.4	3.2
Miscellaneous Hard Goods	883,401	803,214	866,669	917,516	886,355	1,101,414	1,132,502	4.6	3.7	3.9	4.4	3.9	4.2	4.2
Construction	1,633,367	1,524,343	1,469,732	1,201,347	1,186,345	1,213,778	1,436,452	8.5	7.0	6.2	5.7	5.2	4.6	4.2
All Actions of Less Than $10,000	1,280,936	1,312,026	1,500,532	1,542,665	1,665,281	2,116,796	2,269,370	6.7	6.0	6.6	7.2	7.2	8.1	9.6
										Percent of All Business Firms				
SMALL BUSINESS FIRMS FOR WORK IN THE U. S. (SUB-TOTAL)	3,782,526	3,729,018	3,782,850	3,439,532	3,656,527	4,622,069	4,201,101	19.8%	17.1%	16.6%	16.1%	15.9%	17.7%	15.8%
MAJOR HARD GOODS (Sub-Total)	573,148	641,803	710,996	636,684	751,251	1,106,546	969,227	5.3	3.9	4.6	4.3	4.5	5.9	5.2
Aircraft	142,737	123,305	179,091	126,161	145,261	162,135	154,141	2.8	1.7	2.7	2.6	2.9	3.2	2.8
Missile Systems	36,236	41,258	62,212	58,976	72,693	90,972	108,657	1.9	1.5	1.4	1.2	1.2	1.4	1.6
Ships	125,316	80,666	90,031	87,960	116,838	188,806	166,214	13.5	12.4	8.2	8.7	8.6	12.8	9.5
Tank-Automotive	42,069	45,257	56,785	56,763	60,529	145,968	71,420	11.5	9.1	16.8	14.6	10.5	14.0	6.9
Weapons	16,740	21,713	26,080	22,892	43,147	84,690	46,442	6.1	10.2	13.9	19.0	30.2	38.5	21.7
Ammunition	62,415	36,167	44,965	47,152	50,081	103,764	99,455	14.4	12.1	12.6	9.9	9.1	11.3	11.2
Electronics & Communication Equipment	177,915	193,417	253,322	234,780	262,982	330,191	357,594	9.4	9.7	10.3	7.8	8.3	10.0	11.7
SERVICES	269,175	226,512	283,591	283,126	269,025	372,280	318,049	9.7	8.3	12.5	21.4	24.7	34.2	21.1
ALL OTHER (Sub-Total)	2,940,203	2,860,703	2,838,273	2,519,889	2,636,287	3,143,243	2,984,825	52.6	56.8	52.3	48.7	49.8	49.9	45.2
Subsistence	256,841	247,398	265,471	268,690	261,548	330,028	300,603	50.3	53.5	54.1	57.3	55.8	57.4	51.3
Textiles, Clothing & Equipage	202,797	153,309	124,482	119,894	147,284	252,102	161,604	61.3	63.3	70.1	67.8	55.9	61.9	62.5
Fuels & Lubricants	232,856	267,888	210,227	176,971	199,127	194,632	177,365	24.5	30.9	21.4	20.6	24.3	22.0	20.2
Miscellaneous Hard Goods	363,118	312,757	336,600	354,632	328,281	417,867	362,891	41.1	38.9	38.8	38.7	37.0	37.9	32.0
Construction	1,039,194	1,110,456	948,132	603,963	635,707	580,608	563,392	63.6	72.8	69.1	50.0	53.6	47.8	51.5
All Actions of Less Than $10,000	345,397	868,895	983,361	995,679	1,064,340	1,368,006	1,398,970	66.0	66.2	65.4	64.5	63.9	64.6	53.6

a/ For definitions and coverage, see notes on coverage.
b/ Includes Other Defense Agencies beginning with fiscal year 1963.

Source: U.S. Department of Defense, Military Prime Contract Awards and Subcontract Payments, July 1963 - March 1964 (Washington, D.C., 1964), p. 22.

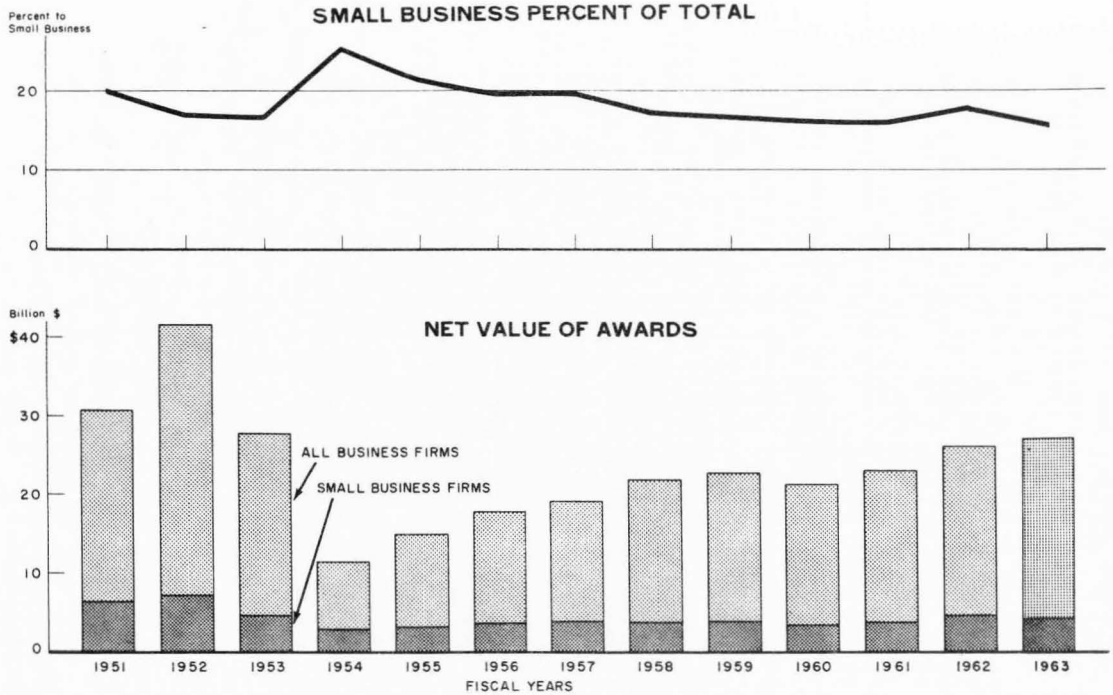

Figure 1. Awards to small and other business firms

Source: U.S. Department of Defense, Military Prime Contract Awards and Subcontract Payments, July 1963 - March 1964 (Washington, D.C., 1964), p. 13.

weapons brought about a steady increase in the total value of military procurement in each subsequent fiscal year, except for fiscal year 1960, when there was a moderate decline. The small business dollars increased to $3.7 billion by fiscal year 1957, and remained approximately at that level through fiscal year 1961. During fiscal year 1962, resulting from the emphasis placed on increasing the small share of the defense dollar by the executive branch, small business firms received $4.6 billion in military prime contracts, the highest since the peak Korean War year of 1962. There was a decline to $4.3 billion in fiscal year 1963.[14]

As shown in Table 8, for the seven fiscal years from 1957 through 1963, small firms averaged $3,653,000,000 per year in reported subcontract receipts and $3,902,000,000 in direct prime contracts, a total of $7,555,000,000 in defense business per year. In this same period, average annual military prime contract awards to all business firms were $23,041,000,000.[15]

Not all military prime contractors and subcontractors took part in the Department of Defense subcontracting program which requires the reporting of subcontract payments and therefore the reported volume of subcontract payments to small business firms may be understated. Up to January 1960, the Defense Small Business Subcontracting Program was on a voluntary basis. On January 1, 1960, the program became mandatory for all prime contractors, and also on all subcontractors, who obtained contracts of $1 million or more with substantial subcontracting possibilities.

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[14]U.S. Department of Defense, Military Prime Contract Awards and Subcontract Payments, July 1963--March 1964 (Washington, D.C., 1964), p. 7.

Table 8. Defense small business subcontracting program, by fiscal year (dollar amounts in millions)

	1957	1958	1959	1960	1961	1962	1963
1. Number of Large Contractors Reporting Their Subcontract Receipts and Payments to Department of Defense	298	294	298	298	309	378	453
2. Military Subcontract Payments by Reporting Contractors, Total	$9,314	$9,026	$9,144	$9,666	$9,407	$10,560	$11,411
a. To Small Business Concerns	3,562	3,242	3,336	3,587	3,495	4,011	4,341
b. To Other Business Concerns	5,752	5,784	5,808	6,079	5,912	6,549	7,070
3. Percent of Total Paid to Small Business Concerns (Line 2a ÷ Line 2)	38.2%	35.9%	36.5%	37.1%	37.2%	38.0%	38.0%
4. Military Contract Receipts by Reporting Contractors from Prime and Subcontract Work	$16,992	$17,479	$18,704	$19,095	$19,803	$22,337	$23,667
5. Percent of Receipts Paid Out to All Business Concerns (Line 2 ÷ Line 4)	54.8%	51.6%	48.9%	50.6%	47.5%	47.3%	48.2%

Source: U.S. Department of Defense, Military Prime Contract Awards and Subcontract Payments, July 1963 - March 1964 (Washington, D.C., 1964), p. 49.

Effective January 1, 1962, the $1 million limitation was cut to $500,000.[16] Thus with greater participation and more accurate reporting, future statistics should present a truer picture.

Table 8 shows for the fiscal years 1957 through 1963, the total receipts of large concerns for military contracts and in turn, the amounts these concerns paid to small and other business firms for subcontract work. Over the seven-year period, large concerns paid subcontractors 49.6 percent of the total amount they received on military contracts, and small business firms received 37.3 percent of the total subcontracts.[17]

The Subcontracting Program

Prime contractors, those who have direct contracts with the government, like any other business, utilize a portion of their recipts to buy goods and services from other firms. The transactions involved are basically of two types: The purchase of materials and parts at fixed prices, transactions that are similar to those in the rest of the economy; and the purchase by subcontract of subsystems. The latter generally involves a continuing contractual relationship between purchaser and seller for a development effort rather than the sale of a finished off-the-shelf item. These subcontracts involve the development of such items as air conditioning units, ground handling equipment, test equipment, and guidance systems. These items usually require an extensive development effort, and are especially designed for a particular

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[16] Ibid.

[17] Ibid.

weapons program, and usually require engineering skills that the prime contractor does not normally possess.[18]

It is generally recognized that the growing technological complexities involved in producing military and space items for the government are reducing the prime contract opportunities for small concerns. Consequently, efforts are being made to expand the role of small business in defense contracting via the subcontracting route.[19]

The government has mounted an intensive program to assure that small business has the opportunity to broaden its participation in defense procurement through subcontracting. The enactment of Public Law 87-305 on September 26, 1961, required the enactment of a subcontracting program jointly by the Department of Defense, the Small Business Administration, and the General Services Administration. The regulations implementing this program are contained in the Armed Services Procurement Regulations and in the Federal Procurement Regulations.

The subcontracting program requires that government contracting officers insert clauses into contracts over $500,000 which will require prime contractors to establish formal small business subcontracting programs and to file required reports to the procurement agency on these activities. Further, it provides for periodic reports of these subcontracting activities by the procurement agency to the Department of Defense for monitorship purposes. In contracts of over $5,000 estimated costs, contractors are "urged" to accomplish the maximum

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[18]Peck and Scherer, p. 147.

[19]U.S. Senate, Select Committee on Small Business, Small Business Administration--1963, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 26. Cited hereafter as Small Business Administration--1963.

amount of subcontracting that they consider to be consistent with the efficient performance of the contract. However, no reporting to the procurement agency is required.[20]

Additionally, under this program, major contractors are required to maintain records reflecting how many large and how many small firms were solicited for subcontracts; how many large and how many small firms bid; what firm received the award and, if applicable, why small business did not receive the award. In addition to the procurement agency involved, the Small Business Administration has access to these records.[21]

The jointly developed subcontracting program has three objectives:

(1) to enable small concerns to be considered fairly as subcontractors and suppliers to the government contractors and subcontractors;
(2) to insure that the latter concerns will, at the request of the SBA, consult with SBA through the appropriate procuring agencies; and
(3) to enable SBA to obtain from any government procurement agency such available or reasonably obtainable information and records concerning subcontracting by its prime contractors and their subcontractors, as SBA considers necessary.[22]

These objectives and their implementing directives give the SBA a great deal of altitude in the subcontracting program, but does not provide the SBA with the authority to dictate to a prime contractor to award a subcontract to one business concern rather than another. The SBA states:

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[20] Ibid., p. 44.

[21] Katherine Johnsen, "Small Business Share Grows in Contracts," Aviation Week and Space Technology, Mid-December 1962, p. 74.

[22] Small Business Administration--1963, p. 26.

> Our means in dealing with a prime contractor who may fail or refuse to utilize qualified small business sources is the power of reason. It is our task to dissuade him from continuing the practice by emphasizing the resulting injury to a vital segment of the national economy, and, where possible, by pointing out resulting injury to his own business.[23]

In order to increase the participation of small business concerns in government subcontracting, the Small Business Administration seeks to identify the types of procurement which are potentially susceptible to small business participation. The role of the prime contractor is to provide adequate descriptive material which clearly identifies the product or service being purchased. The Small Business Administration then seeks to provide the names of those small business firms which can provide the product or service to the prime contractor. Each regional SBA office maintains a register of small business firms that have listed their productive facilities for the geographic territory served by the office to aid in this endeavor. This information is also centrally maintained in Washington, D.C. This system enables the Administration to make timely referrals of small business concerns to the major prime contractors participating in the subcontracting program. This facilities inventory contains the names of over 50,000 small firms and provides a clearinghouse through which the government and large contractors may obtain information about small firms capable of meeting their needs.[24]

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[23] Ibid.

[24] Ibid., p. 35.

Set-Aside Program

The set-aside program is another of the vehicles for increasing the participation of small business in the procurement of defense supplies and services. The set-aside program is one by which certain contracts are set aside for exclusive competition among small business firms to the exclusion of large business concerns. It is authorized in section 15 of the Small Business Act of 1958, as amended, and in the Armed Services Procurement Regulations, as follows:

> It is the policy of the Department of Defense to place a fair proportion of its total purchases and contracts for supplies, research and development, and services (including but not limited to, contracts for maintenance, repair, and construction) with small business concerns.[25]

Further, it is stated that:

> . . . any individual procurement or class of procurements or an appropriate part thereof, shall be set aside for the exclusive participation of small business concerns when such action is (i) jointly determined by an SBA representative and the contracting officer upon the initiation of either agency, or (ii) if no SBA representative is available, is unilaterally determined by the contracting officer to be in the interest of maintaining or mobilizing the nation's full productive capacity, or in the interest of war or national defense programs, or in the interest of assuring that a fair proportion of government procurement is placed with small business concerns.[26]

The emphasis placed on the set-aside program was one of the major reasons for the marked increase in prime contractual awards to small business in fiscal year 1962. As shown in Table 6, this year saw the highest percentage of awards given to small business since 1957, as well as the highest dollar amount being awarded.[27]

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[25] Armed Services Procurement Regulation 1-702 (Washington, D.C., 1964), p. 144.1

[26] Armed Services Procurement Regulation 1-706.1 (Washington, D.C., 1964), p. 148.

[27] The Role of Small Business in Government Procurement--1962-63, p. 3.

The use of small business set-asides was sharply increased, reaching the highest level in five years. The increase from $1.21 billion in 1961 to $1.77 billion in 1962 in total set-asides as reflected in Table 9 was extremely significant, particularly when these statistics reflect a 46.3 percent increase in these types of awards by the Department of Defense to small business.[28]

Table 9. Set-asides agreed to and set-aside procurement awards

	Fiscal year 1961	Fiscal year 1962	Percent increase
Total (agreed to)	$1,647,651,751	$2,295,074,782	39.3
Department of Defense	1,434,565,963	1,965,465,648	37.0
Civilian agencies	213,085,788	329,609,134	54.7
Total (awards)	$1,216,801,518	$1,773,803,530	45.8
Department of Defense	1,052,414,134	1,539,174,044	46.3
Civilian agencies	164,387,384	234,629,486	42.7

Source: U.S. Senate, Select Committee on Small Business, The Role of Small Business in Government Procurement--1962-1963, 87th Cong., 2nd Sess. 1962 (Washington, D.C., 1962), p. 11.

[28] Ibid., p. 4.

Also noteworthy is the fact that the awards resulting from the use of set-asides represent 36 percent of the total awards awarded by the Department of Defense to small business concerns during fiscal year 1962.[29] As reflected in Table 10, the dollar amount of the set-asides agreed to exceeded the quantities awarded. This is normal, inasmuch as small business concerns are not always interested or capable of performing in all contracts which are set aside for them and consequently many of them will revert to large business concerns.

Table 10. Joint set-asides, comparison of fiscal years 1954-1962 [a]

Fiscal year	Agreed to		Awarded	
	Number of contracts	Amount	Number of contracts	Amount
1954	1,621	$ 228,504	1,249	$ 101,690
1955	3,924	386,611	3,742	193,777
1956	6,075	497,678	8,140	344,810
1957	11,851	744,335	13,416	552,573
1958	17,819	1,062,454	18,149	676,749
1959	22,338	1,142,625	24,800	848,570
1960	21,592	1,102,935	24,152	878,169
1961	34,256	1,647,652	34,272	1,216,802
1962	44,839	2,295,075	56,944	1,773,804

[a]Dollar value in thousands.
Source: U.S. Senate, Select Committee on Small Business, The Role of small Business in Government Procurement--1962-1963, 87th Cong., 2nd Sess. (Washington, D.C., 1962), p. 11.

[29]Ibid.

Increasing Competition

Providing increased opportunities for competing for defense work to small business concerns is another objective of the Department of Defense and the Small Business Administration.

The policy of sole source procurement or noncompetitive procurement by the Department of Defense has been the subject of criticism by Congress. The critics of sole source procurement have two major complaints about this policy. First, they contend that it closes the door to small companies in bidding for defense work; second, the lack of competition results in added costs to the Department of Defense for its purchases of supplies and services.

Contract award statistics show that a large portion of defense contract dollars are obligated without any direct interfirm competition.

> The military departments were asked to furnish a machine tabulation of all such sole source purchases accomplished in the period April--June 1959, a period during which total defense expenditures amounted to $7.3 billion. The results of the compilation indicated that of this total, $5.6 billion was awarded noncompetitively. Needless to say, each of these sole source actions was negotiated rather than formally advertised.[30]

In addition to the efforts in the subcontracting and set-aside programs, the Department of Defense has taken steps to increase competition by reducing the amount of sole source procurement and increasing formal advertising. By so doing, it offers greater opportunities for small business participation in defense work. Thomas D. Morris, Assistant Secretary of Defense (Installations and Logistics), made the following statement in this regard:

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[30]U.S. Senate, Select Committee on Small Business, Government Procurement--1960, 87th Cong., 1st Sess (Washington, D.C., 1961), p. 1.

> I would like to stress the fact that there is a very important relationship between the accomplishments made in assuring a fair share of Defense procurement to small business, and in our objective to increase the total volume of procurements awarded on the basis of price competition. Last year we awarded 35.6 percent of our total purchases on the basis of formal advertising and other forms of price competition as compared to 32.9 percent in fiscal year 1961. This means that approximately $650 million in purchases were converted from a sole source to a price-competitive basis. Our studies show that each dollar spent under price competition buys at least 25 percent more. Hence, it can be seen that our smaller business program serves a dual function--(1) it opens up more opportunities for small firms; and (2) it provides an added incentive to our technical personnel to seek out opportunities for competitive procurement with the accompanying cost reduction benefits. Hence, there is a double bonus which accruse from a vigorous small business program in the Department of Defense.[31]

Research and Development

Another area in which attempts have been made to increase small business participation has been in research and development. However, the results have been less than satisfying to Congress.

The following quotation indicates the feeling of the Select Committee on Small Business of the United States Senate concerning the concentration of military research and development.

> Among all the forces that contribute to the growth of monopoly power, few operate more insidiously than the overloading of giant corporations with military production contracts in the hands of a few score corporations (many of which while organized, as private enterprises, are so substantially supported through defense contracts as to have the characteristics of Government arsenals), may reduce the present profits of qualified small companies, the even greater concentration of research and development contracts i n the hands of big corporations (currently about 96.5 percent) has the effect of closing the door of existence to many small companies.[32]

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[31] The Role of Small Business in Government Procurement--1962-1963, p. 5.

[32] Eleventh Annual Report, p. 5.

It is estimated that every research and development dollar spent generates $7.00 worth of sales in about five years. It is also stated that those companies not having active research and development programs are courting disaster. Since the government pays for 60 percent of all research performed by American industry, the conclusion is reached that concentration of research contracts in the laboratories of large corporations guarantees them that they will enjoy a formidable headstart over smaller companies in the development of consumer products which are often the inevitable by-product of military research contracts.[33] This committee goes on to state:

> With this basic reality in mind, it may well be that those in the Defense Department of good will toward small business, urged and aided by their counterparts in the Small Business Administration, will want to develop a joint crash program to break the monopoly of research and development contracts now so tightly held by the Nation's corporate giants.[34]

Table 11 shows the extent of awards for research and development to small business. Despite the interest shown by the Senate Small Business Committee and the various programs established by the Department of Defense to increase the placement of research and development contracts with small business, these actions have not been too effective. Although an absolute dollar value increase in contract awards to small business for research and development work went from $161.3 million to $197.7 million between fiscal years 1961 and 1963, along with an increase in the percentage of total awards from 2.9 percent to 3.5 percent, the percentage dropped to 2.7 percent for the first nine months of fiscal year 1964.[35]

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[33] Ibid.

[34] Ibid.

[35] Military Prime Contract Awards and Subcontract Payments, p. 24.

Table 11. Awards for experimental, developmental, test and research work, by type of contractor[a] (amount in thousands)

Type of Contractor	FY 1956	FY 1957	FY 1958	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	Jul 62-Mar 63	Jul 63-Mar 64
TOTAL	NA	NA	NA	NA	NA	$6,649,537	$6,128,396	$6,244,824	$4,251,025	$4,373,767
INTRAGOVERNMENTAL	NA	NA	NA	NA	NA	7,506	15,595	18,343	14,363	32,554
FOR WORK OUTSIDE U. S.	NA	NA	NA	NA	NA	18,389	13,904	13,908	8,472	18,028
TOTAL, EXCEPT INTRAGOVERNMENTAL AND FOR WORK OUTSIDE U. S.	$2,404,440	$3,256,371	$4,031,036	$5,239,057	$5,551,054	$6,023,402	$6,099,597	$6,212,643	$4,228,193	$4,323,185
Army	387,205	485,149	624,932	772,931	755,045	755,657	793,910	832,322	554,914	697,859
Navy	516,117	713,148	986,831	1,254,372	1,580,122	1,465,795	1,087,299	1,238,642	802,956	735,914
Air Force	1,501,118	2,111,074	2,419,273	3,211,754	3,215,287	3,901,951	4,214,392	4,101,885	2,870,323	2,889,412
Other Defense Agencies b/	---	---	---	---	---	---	---	39,794	---	---
PERCENT OF ALL MILITARY PROCUREMENT	13.5%	16.8%	18.1%	22.6%	25.6%	26.7%	22.9%	22.4%	21.6%	22.7%
Army	10.1	9.5	12.4	15.4	15.0	12.3	12.3	14.4	14.3	15.5
Navy	9.1	12.0	15.5	17.8	23.0	20.0	13.3	15.5	14.9	12.3
Air Force	18.1	23.8	22.4	29.2	32.8	36.3	38.2	35.7	34.3	39.7
Other Defense Agencies b/	--	--	--	--	--	--	--	21.8	--	-
EDUCATIONAL & NON-PROFIT INSTITUTIONS c/	NA	223,228	288,107	340,465	316,809	373,638	429,727	525,805	353,841	415,577
Army		71,377	101,998	91,399	63,794	48,582	57,504	73,784	50,586	50,282
Navy		62,849	87,445	94,498	126,562	133,136	134,046	170,076	114,249	120,677
Air Force		89,002	98,660	154,068	130,453	191,914	238,797	252,352	189,026	244,638
Other Defense Agencies b/		---	---	---	---	---	---	29,593	--	---
PERCENT OF ALL PROCUREMENT FROM EDUCATIONAL & NON-PROFIT INSTITUTIONS	NA	85.6%	72.9%	85.2%	83.4%	86.5%	85.6%	85.1%	85.5%	91.6%
Army		69.2	51.6	65.2	57.3	86.4	88.1	85.9	89.5	80.6
Navy		96.8	97.3	97.1	97.6	99.4	91.1	96.1	96.0	95.9
Air Force		96.0	91.8	95.5	91.2	81.2	82.2	79.8	80.3	92.9
Other Defense Agencies b/		--	--	--	--	--	--	76.6	--	--
BUSINESS FIRMS FOR WORK IN THE UNITED STATES	2,404,440	3,033,143	3,742,929	4,898,592	5,234,245	5,649,764	5,669,870	5,686,838	3,874,352	3,907,606
Army	387,205	360,772	522,934	681,532	691,851	607,068	736,226	758,538	504,348	647,597
Navy	516,117	650,299	899,382	1,159,374	1,457,560	1,332,659	953,049	1,068,566	688,707	615,237
Air Force	1,501,118	2,022,072	2,320,613	3,057,686	3,084,834	3,710,037	3,980,595	3,849,533	2,681,297	2,644,774
Other Defense Agencies b/	---	---	---	---	---	---	---	10,201	---	---
PERCENT OF ALL PROCUREMENT FROM BUSINESS FIRMS	13.5%	15.9%	17.1%	21.5%	24.6%	24.6%	21.7%	21.0%	20.8%	21.0%
Army	10.1	8.1	10.8	13.7	14.1	11.5	11.5	13.4	13.2	17.4
Navy	9.1	11.0	14.3	16.7	21.6	18.6	11.9	13.7	13.1	10.5
Air Force	18.1	23.0	21.7	28.2	32.0	35.2	37.1	34.4	32.9	37.8
Other Defense Agencies b/	--	--	--	--	--	--	--	7.1	--	--
SMALL BUSINESS FIRMS	137,076	130,502	138,686	169,962	179,687	161,307	197,126	197,970	108,172	104,754
Army	36,569	35,732	37,267	51,855	42,855	28,598	41,950	48,938	26,734	25,231
Navy	45,751	54,826	52,868	66,744	79,457	72,278	89,096	75,801	41,091	40,131
Air Force	54,756	39,944	48,551	51,363	57,375	60,431	70,080	69,533	40,347	39,392
Other Defense Agencies b/	---	---	---	---	---	---	---	3,698	---	---
SMALL BUSINESS PERCENT OF EDTR FOR BUSINESS FIRMS	5.7%	4.3%	3.7%	3.5%	3.4%	2.9%	3.5%	3.5%	2.8%	2.7%
Army	9.4	9.7	7.1	7.6	6.2	4.7	5.7	6.5	5.3	3.9
Navy	8.9	8.4	5.9	5.8	5.5	5.4	8.9	7.1	6.0	6.5
Air Force	3.6	2.0	2.1	1.7	1.9	1.6	1.8	1.8	1.5	1.5
Other Defense Agencies b/	--	--	--	--	--	--	--	36.3	--	--

a/ For definitions and coverage, see Notes on Coverage.
b/ Available on annual basis beginning with fiscal year 1963.
c/ Prior to fiscal year 1957, data on Educational and Non-Profit Institutions were included in the data for "Business Firms for Work in the U. S."

NA - Not available.

Source: U.S. Department of Defense, Military Prime Contract Awards and Subcontract Payments, July 1963 - March 1964 (Washington, D.C., 1964), p. 24.

The Department of Defense has a program which requires that contracting officers consider small concerns for research and development work. If small business is not solicited, a statement to this effect must be included in the procurement file setting forth the reasons for non-solitication.[36] Consideration was given to using set-aside procedures for the purchases of research and development by the Department of Defense; however, the following statement reflects their position on this matter.

> We have concluded that should the small business set-aside procedure be adopted for R and D contracts, the Government would rule out of consideration large firms whose potentially superior competence (in the set-aside cases) would be lost to the military services in the development of military items. Therefore, we believe that it is not in the interest of the Government to adopt the set-aside technique in this extremely important area of procurement.[37]

This official position of the Department of Defense would appear to rule out any appreciable increase in the future on the amount of research and development awards to small business.

Organized Aid to Small Business

Overseeing the efforts of the Department of Defense and the Small Business Administration to provide a larger share or defense dollars to small business concerns is the Select Committee on Small Business of the U.S.Senate and the Select Committee to Conduct a Study and Investigation of the Problems of Small Business of the U.S. House of Representatives. Both groups are unanimously authorized each session of Congress to

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[36]The Role of Small Business in Government Procurement--1962-1963, p. 8.

[37]Ibid. Statement by Thomas D. Morris, Assistant Secretary of Defense (Installations and Logistics).

continue their activities on behalf of small firms. Annual public hearings before the Senate group focus attention on government procurement policies programs and projects aimed at strengthening the position of small business. In addition, both committees have staffs which can handle the individual problems of small firms on an individual basis during the year.[38]

The Small Business Administration, which exists for the sole purpose of aiding and protecting small business, is one of the fastest growing agencies in Washington. The following figures reflect the growth of personnel in this agency since fiscal year 1959 and October 31, 1963:[39]

October 31, 1963	3,258
June 30, 1962	3,140
June 30, 1961	2,633
June 30, 1960	2,244
June 30, 1959	2,013

Noteworthy, is the growth between 1961 and 1962 (fiscal year 1962). This was during the period when the President first began to give emphasis to the small business program. Personnel of this agency are located all over the country--750 being located in Washington and the balance in the field.[40] A budget of $35 million provides this group with the means for the fulfillment of its objectives.[41]

Cooperating with the Small Business Administration is the wide-flung organizational resources of the Department of Defense. The Defense Department has a Directorate of Small Business which has equal status with the Directorate for Procurement Policy and the Directorate for Procurement

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[38]"Small Business Share Grows in Contracts," p. 74.

[39]Small Business Administration--1963, p. 8.

[40]"Small Business Share Grows in Contracts," p. 75.

[41]Small Business Administration--1963, p. 8.

Management under the Assistant Secretary of Defense for Installations and Logistics. These agencies, between them, formulate policies governing the total procurement activities of the Department of Defense. In addition, the Army, Navy, Air Force, and Defense Supply Agency each have small business offices at the Pentagon.

To carry out the program formulated in Washington to aid small business, the defense establishment has small business specialists located at 500 depots, commands, and other installations that engage in procurement throughout the country.[42]

Further, the Commerce Department publishes the Commerce Business Daily which tells the small businessman where to look for business. It lists:

> Products and services which individual government procurement offices are planning to buy currently; proposed procurements by all government agencies; subcontract opportunities by defense prime contractors, and prime contract awards, which furnish leads to possible subcontract possibilities.[43]

All in all, the government's organization and programs for providing guidance, and assistance in obtaining a greater share of the defense dollar are extensive.

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[42] "Small Business Share Grows in Contracts," p. 75.

[43] Ibid.

CHAPTER V

RESEARCH AND DEVELOPMENT

The Role of the Government

Society is living through an accelerating scientific revolution which is leaving no part of our culture untouched. The federal government is playing a central role in this revolution through its participation in and sponsorship of research and development in all areas. The vast expenditures of funds for this purpose have had myriad effects.

Changes are being wrought which affect our personal lives, our institutions, and our industries. Numerous benefits have accrued to the economy resulting from this research, although the major portion has been related to military projects. Completely new types of organizations have been created as a result of government-sponsored research. Further, development-oriented industries, such as aircraft, missiles, and electronics, now receive greater attention than the traditional large manufacturing industries such as automobiles, machinery, and steel.

Since the United States Government plays such a central role in this scientific revolution which affects our social, economic, and political lives, it is essential that the impact of government participation and policies in research and development be fully understood. Research has become so large, that if it were to be classified as an industry it would rank among the top twelve manufacturing industries. There are 350,000 people employed in research and development--close to

65 percent of the number employed in the auto industry.[1] It certainly ranks with big industry, considering the billions expended for research each year.

Table 12 reflects the increasing government expenditures in all areas of research, particularly for national defense which consumes over 65 percent of the federal research dollar.

Table 12. Federal expenditures for research and development, fiscal years 1953-1963 (in millions of dollars)

Fiscal year	National defense[a]	Other	Total
1953	2,832	269	3,101
1954	2,868	280	3,148
1955	2,979	289	3,268
1956	3,104	332	3,435
1957	4,027	433	4,460
1958	4,463	523	4,985
1959	5,048	744	5,792
1960	6,639	1,103	7,742
1961	7,719	1,572	9,291
1962	7,820	2,424	10,244
1963	8,572	3,793	12,365

[a]Amounts included in this table under "National defense" for the Department of Defense have been compiled from the best available summary data to provide maximum possible comparability for the years shown.

Source: Report to the President on Government Contracting for Research and Development, April 30, 1962.

[1]"Research: Leave How Much to Uncle Sam?" Business Week, December 23, 1961, p. 53.

Table 13 indicates the sources and distribution of funds for all research, government and private. It further identifies the amount of research being performed by basic groups. These statistics reveal that about two-thirds of all research and development expenditures are made by the federal government; but that it performs only 15 percent of the

Table 13. Summary information concerning the distribution of national research and development funds[a]

	National research and development expenditures (in millions of dollars) Fiscal years				
By source of funds	1954	1955	1959	1960	1961
Federal government	$2,740	$3,070	$7,170	$8,290	$9,220
Industry	2,240	2,365	3,620	4,030	4,490
Universities and university research centers	130	140	190	200	210
Other not-for-profits	40	45	90	100	120
Total	$5,150	$5,620	$11,070	$12,620	$14,040
By performer					
Federal government	$ 970	$ 950	$1,730	$1,830	$2,060
Industry	3,630	4,070	8,300	9,550	10,500
Universities and university research centers	450	480	840	1,000	1,200
Other not-for-profits	100	120	200	240	280
Total	$5,150	$5,620	$11,070	$12,620	$14,040

[a]This table illustrates the growth of the total national expenditures for research and development and their distribution among basic types of performing institutions and types of functions.

Source: Report to the President on Government Contracting for Research and Development, April 30, 1962. Prepared by the Bureau of the Budget (Washington, D.C., 1962), p. 277.

nation's total research and development in its own laboratories while expending approximately 20 percent of its own outlays in federally-owned laboratories. About two-thirds of the federal expenditures are made through contracts with industry and over 10 percent with university and other non-profit organizations. There was an increase of 236 percent in government-sponsored research from 1954 until 1961, with a corresponding increase of 173 percent for all research during the same period.

To bring these figures up-to-date in the fiscal year 1963, a total national expenditure of $16 billion for research and development, $12 billion was for government objectives and only 25 percent went to the civilian economy. The federal research effort is programmed at almost $15 billion in 1964 with $7.6 billion for defense and $4.2 billion for the National Space Agency, which is to a great extent related to the defense effort and which can be identified with aircraft and missile technology.[2]

Balance between Defense and Civilian Purposes

Industry, represented by the U. S. Chamber of Commerce, feels that these expenditures indicate that there is a serious imbalance between research for national defense and research for civilian purposes.[3]

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[2]U.S. Congress, Subcommittee on Defense Procurement, of the Joint Economic Committee, Impact of Military Supply and Service Activities on the Economy, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 162. Helge Holst, corporate counsel for Arthur D. Little, Inc., an industrial research firm representing the U.S. Chamber of Commerce, appeared before the Subcommittee on Defense Procurement, Of The Joint Economic Committee and submitted a prepared statement and provided other testimony. Cited hereafter as Holst.

[3]Holst, p. 162.

The Chamber does not deny the need for strong military defense, but feels that a greater balance is necessary between research and development expenditures devoted to military and civilian purposes. The Chamber's representative explained that research and development contribute substantially toward the goals of full employment and a rising standard of living, with its contribution of new products, new industries, and new processes which increase productivity, thereby providing employment for an expanding force and maintaining costs within limits, which make the resulting outflow of goods and services widely available. However, there is overwhelming evidence which indicates that the limited research and development resources have been increasingly diverted from civilian industrial purposes to primarily military and space programs. With only 25 percent of research and development expenditures going towards civilian-oriented programs, the national Chamber asserts that the extent of this diversion be recognized. It is considered very serious that the United States effort in civilian-oriented research is well below that of other major industrial countries (such as Japan, West Germany, and others). Proportionally, the United States research and development talent devoted to civilian industry and commerce is only half that of West Germany. It is asserted by the United States Chamber of Commerce that this is a potential cause of lagging employment and a deterrent to increased productivity.

The Chamber continues and argues strongly for national policy to have as its objective recognition of the relative importance of a sound economy as weighed against the prestige value of a space exploration or overkill in military defense. Considering that the government's

needs must absorb a substantial portion of the nation's research and development, the Chamber asks two questions ". . . in what ways can this be handled so as to produce minimum diversions from the private sector?" And "What unnecessary practices have contributed to the present situation and how might they be changed?"[4]

What is it that needs changing? According to the Chamber, government contractual policies regarding research performed by private organizations tend to isolate this work from the civilian industrial effort, thereby increasing costs and requiring larger amounts of personnel, both scientific and other. Further, the great amounts of research and development being accomplished in government laboratories by government personnel shows up in a duplication of closely related projects and also in duplicate staffs and facilities. Joint use of personnel and facilities between the various services in the Department of Defense do not often use common facilities. The limited resources of the nation cannot afford this luxury of duplication: ". . . 'single' service or shared operation of a single facility would promote efficiency and achieve a greater degree of transfer of technology and experience from one project to another."[5]

Duplication of Research

An opposing view to this matter of centralization of research and elimination of duplication in research and development efforts is founded on the basis that because of the uncertainties involved, some duplication is desirable and there has been, at times, too little duplication. The

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[4] Ibid., p. 163.

[5] Ibid., p. 164.

state of the art has not yet reached the point where precise answers can be given as to how much duplication there should be. "There is a strong case for some duplication in the development of critical weapons systems, despite their great cost, because of the disastrous consequences if the one horse that we back runs last."[6] Depending upon the magnitude of the problem and the uncertainties of the development, several approaches may be necessary--perhaps completely independent approaches using competing contractors. There should also be greater duplication, the less it costs to duplicate. As a result of the uncertainties and when duplications are relatively inexpensive, a great deal of "temporary" duplication is desirable. As more knowledge is gained and the more expensive stages of development are reached, the number of routes to be followed should be decreased.

Related to too little duplication is too little competition. Either is possible without the other. Duplication without competition occurs when multiple paths are taken by the same organization. Competition without duplication may occur, as an example, when the Army and the Navy compete for the budget dollar, even though they may never develop the same type of weapons. As in any competition, there is a certain amount of stimulation to those engaged in research in the fear that another laboratory will beat it to the objective. Competition between the military services has proven beneficial in the past. The criticisms of duplication and competition are based on a fundamental misconception of the nature of research and development. The treatment of the uncertain

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[6]Charles J. Hitch and Roland N. McKean, The Economics of Defense in the Nuclear Age (Cambridge, Mass.: Harvard University Press, 1960), p. 249.

as certain is responsible. Suppression of competition and duplication occurs because

> Particular duplications are obviously wasteful from the vantage point of hindsight, apparently unaware that duplication is a rational necessity when we are confronted with uncertainty and that competition is our best protection against bureaucratic inertia.[7]

Military research and development is being criticized for precisely those characteristics which it has in common with research and development in the private sector. Research and development in the American economy is uncoordinated, without central planning or direction and with a great deal of duplication and rivalry. And with the aid of hindsight, one can find waste.[8]

Benefits of Military Research to the Civilian Sector

In regard to waste, it is indeed a waste if the secondary benefits of military research and development as applicable to the civilian economy are not full realized; however there have been significant benefits gained by the private sector from military research in many areas. The research and development efforts in aircraft and engines have certainly spilled over into benefits for commercial aviation. There are many good examples, and if these benefits both direct and indirect, could be totalled, the amount would be staggering.

Military research and development is like any other research and development in that it seeks new knowledge, techniques, and products.

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[7] Ibid., p. 256.

[8] Ibid., p. 257.

It differs from civilian research and development only to the extent that its search is for knowledge, techniques, and products to meet military needs. This distinction, however, is much less real than actual. This is so because the term "military" is made up of a complex of activities, many of which have civilian counterparts. The Armed Forces embody activities which are very similar to, or identical with, numerous civilian activities--although the objectives differ.[9] It therefore follows that military research and development results in findings which are of great value to the economy at large.

An early example of such a benefit may be traced back to the contract between Eli Whitney and the United States Government to develop a system of manufacturing interchangeable parts for the production of firearms. The techniques developed then were soon picked up by civilian industry. These developments were basic to the continuation of the industrial revolution at that time and mass production techniques were furthered by Whitney's work. Although this development would have come sooner of later--it did come sooner because of a military requirement, with the resultant benefits to society at large.

A more recent example of a benefit with a transferance value from military research and development to the civilian sector is the development of the electronic computer. The present computer industry is the direct result of Army sponsored research during World War II. Computers were initially developed to calculate trajectory and firing tables because these calculations exceeded the capabilities of the men and machines of

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[9]Herbert E. Striner, et al., Defense Spending and the U.S. Economy, Staff Paper, ORO-SP-57, Operations Research Office, The Johns Hopkins University, Vol. I, June 1959, p. 16.

the Ballistic Research Laboratories of the Ordnance Department, United States Army. As a result of a need for greater speed and accuracy in these computations, a contract was made with the University of Pennsylvania to develop an appropriate type of electronic computer. By 1946, a machine was produced and installed on the Ballistic Research Laboratories. Today the computer industry is rapidly expanding and machines are being applied to problems of industry, universities, and government agencies. In addition to increasing productivity, work once regarded as impractical to perform becomes a daily occurrence with the use of the computer. The actual pay-off of the original $400,000 investment in research and development in 1942 by Army Ordnance cannot be measured since so many fields are affected, directly and indirectly.[10]

Even a later example is the adaptation of the research performed to develop the KC-135, an aerial refueling cargo vehicle to the nation's first jet airliner, the present Boeing 707. It is no more than a modified KC-135 which is used in support of the B-52 weapon system. Similarly, the current expenditures in research and development for modern weapons systems have far-reaching implications for advancements in science and technology in the civilian sector. The benefits cannot be calculated at this time but the advances will surely have a dramatic effect on our way of life.

Primary Benefits of Military Research

Apart from these benefits, the number one benefit to be derived from military research and development is a defense posture which is in consonance with our national policy. It is doubtful that our scientist-

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[10] Ibid., p. 19.

engineers resource base would be as large as it is without the incentive of military research and development. To assert that this limited resource is being diverted from the civilian economy to its detriment and may be a potential cause of lagging employment and a deterrent to increased productivity is to convey the idea that the quantitative costs and side effects of having the government do more of our shopping are known. A better understanding of these economic problems and implications for research and development and military budgets as a whole along with the entire complex of related domestic economic problems is required. ". . . let us not be so bemused by good but incomplete economic theory about these indirect costs that we run undue risks with national security."[11]

The Need for Competent Personnel

Still in the area of the effective utilization of personnel and facilities are the policies related to how much research and development the government itself will conduct with its own personnel and within its own facilities and how much it will contract out. The latter is favored by industry. In a measure this is related to the type of research involved. This has been classified under five basic categories:[12]

1. Fundamental research
2. Supporting research or exploratory development

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[11] Hitch and McKean, p. 81.

[12] U.S. House of Representatives, Subcommittee of the Committee on Government Operations, Systems Development and Management, Part I, 87th Cong. 2d Sess. (Washington, D.C., 1962), p. 204. From the Report to the President on Government Contracting for Research and Development, April 30, 1962. This report was prepared by David E. Bell, Director, Bureau of the Budget, and is known as the "Bell Report." It has been made a part of these Hearings and is reproduced in its entirety on pp. 191-337. Cited hereafter as the "Bell Report."

3. Feasibility studies, operations analysis and technical advice
4. Development and engineering of products, processes or systems
5. Test and evaluation activities

These areas may overlap and there is no clear-cut method of deciding whether to contract out or use government personnel or facilities for any of these particular types of activities. A major criteria for deciding this issue should be based on "getting the job done effectively and efficiently with due regard to the long term strength of the nation's scientific and technical resources."[13]

The management of research and development programs is difficult for the government--regardless of whether the work is being accomplished contractually or organically in government facilities. Decisions concerning the type of work to be done, when, by whom, and at what cost are decisions which must be made by government officials. Full-time, competent government officials responsible to the President and Congress must be in a position to manage these programs and evaluate the results therefrom. These basic management funcations cannot be transferred to the contractor if proper accountability for the performance of public functions and for public use of funds is to be maintained. This does not imply that detailed supervision of each research and development task by government officials is necessary--delegation of responsibility for this detailed administration to those performing the work is essential to its efficient execution. However, recent years have seen instances, particularly in the Defense Department, where contract employees have been permitted to exercise functions which belong to top government officials in research and development activities.[14]

[13] Ibid., p. 214.

[14] Ibid., p. 215.

Recognizing this, it is essential that the government have the best qualified technical and scientific personnel to manage research programs. Due to the relatively low compensation received by government personnel as compared to those in private industry, it has been difficult to obtain and maintain the managerial competence which the government needs to manage its research and development programs.[15]

The need for higher pay for government personnel performing these tasks has been recognized. Higher average starting salaries, and greater annual salary growth over a longer period of time are offered by private organizations. Consequently, the average employee in private industry will have a higher maximum salary expectancy. The difference in favor of the average industrial employee is so great, that at any time during employment, the average employee working for a government contractor having a bachelor's degree can expect to receive a considerably higher salary than the average government employee with a doctor's degree. Further advantages of private employees are reflected in cash bonuses, stock options, etc. This has resulted in the necessity of paying scientists and engineers working on purely civilian efforts salaries comparable to those being paid to the others doing work in government programs.[16] This raises the cost of research and development for all purposes.

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[15] Ibid., p. 280.

[16] Holst, p. 163.

Non-Profit Organizations

Further, in relation to salaries, the creation of non-profit organizations under government auspices for research purposes is viewed with great criticism by some members of Congress.

> These non-profit organizations contract either entirely or almost entirely with the federal government. The employees of such organizations are paid indirectly by the taxpayers to the same extent as employees under civil service are paid directly by the taxpayers. The pertinent major difference is that their pay is higher. Laws have been enacted by the Congress to regulate salaries of civil service employees. No such laws protect the taxpayers from the payment of excessive salaries to the employees of non-profit organizations with government contracts. To a considerable extent, the use of contracts with non-profit organizations is merely a subterfuge to avoid the restrictions of civil service salary scales.[17]

To promote operations research and other analytical services by contract to the Air Force, the RAND Corporation was established after World War II. Other organizations modeled after RAND to provide similar services have also been established. Another type of organizational setup, generally not-for-profit but sometimes for profit, has been created to furnish the government with "systems engineering and technical direction" and to provide other services. Typical examples are the Aerospace Corporation, the MITRE Corporation, the Systems Development Corporation, and the Planning Research Corporation. The Air Force is the major user of the non-profit type of organization--predominantly the Air Force Systems Command which is the major research organization of the Air Force. Probably there will be greater use of more specially created, non-profit corporations to fill this technical gap of "in-house" (government) capability.

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[17]U.S. Congress, House of Representatives Committee on Appropriations, Department of Defense Appropriation Bill, 1962, 89th Cong., 1st Sess (Washington, D. C., 1961), p. 53.

With the advent of missile development, the Air Force found itself unable to cope with the complex technological problems of these programs due to the lack of qualified officers and government employees, although they had been successful in providing technical guidance and expert managerial ability in the development of aeronautical systems. It therefore became necessary, as the tempo of ballistic missile programs and electronics and space technology increased, to turn to the use of non-profit corporations to help provide the technical direction and systems engineering which these new technologies and their increasingly complex weapon systems required. The establishment of these organizations has provided an important means for the formation of a competent research organization for specific tasks more rapidly than could have been possible within the less flexible administrative requirements of the government.[18]

As an example, the Space Technology Laboratories of the Thompson Ramo Wooldridge Corporation was engaged to provide this capability for the Ballistics Missile Division of the Air Research and Development Command of the Air Force. However, the corporate ties of the Space Technology Laboratories with Thompson Ramo Wooldridge, which was producing hardware for the Air Force, caused other industrial competitors to complain; and this culminated in a congressional investigation and orders to the Air Force to change its procedures in this area. This resulted in the formation of Aerospace Corporation, a new non-profit organization, not participating in any type of production, to fulfill this function for the Ballistics Missile Division on all new systems and

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[18]"Systems Command Given New Functions," Aviation Week and Space Technology, September 25, 1961, p. 76.

technical areas under their control. Similarly, Mitre Corporation was organized to provide this technical capability for the electronics area, an essential adjunct to weapons systems development.[19]

Recognizing this lack of technical capability, the Air Force in past years has made major efforts to develop more technically trained officers with an elaborate advanced technical education program in universities, but the supply has been unable to keep up with the increasing requirements of the Air Force through an increasingly broad portion of the technical spectrum. Further, a steady stream of these technically educated officers, seasoned with Air Force operating experience, has flowed out of the service into industry.[20] Consequently, between its increasing requirements and stead attrition of experienced officers and the low pay offered by the government to civilian scientists and engineers, the Air Force has never been able to develop an in-house capability beyond the barest of minimums. Unable to develop its own capability, it was inevitable that the Air Force would have to devise a means to manage the ever-increasing complex of technical direction and systems engineering required in the development of modern weapons systems.[21] And despite the continuing criticisms from Congress and industry, it appears that the non-profit type organization will remain a "way of life" for the Air Force in the area of technical direction and systems engineering.

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[19] Ibid.

[20] Ibid., p. 75.

[21] Sterling J. Livingston, "Weapon System Contracting," Harvard Business Review, XXXVII (July-August 1959), 85.

Competition between Industry and Non-Profit Organizations

Industry has complained of the competition of the government-established non-profit organizations. The Aerospace Corporation in 1961 had a volume of approximately $65 million business from the Air Force, with $30 million allocated to salaries, equipment, and overhead and the remainder used for direct engineering costs of specific projects. Along with the complaint of current competition, is the fear of industry that ultimately the Aerospace Corporation will get into manufacturing and will have a competitive advantage due to their research activities. A further complaint has been voiced concerning the higher pay scales being offered to scientists and the losses of such personnel to Aerospace Corporation from some industrial organizations.[22]

The volume of Defense Department allocations to the non-profit organizations for research has been increasing steadily. The amounts programmed for expenditure with non-profit organizations were $112,484,000 in FY 1963, $136,292,000 in FY 1963, and $152,702,000 in FY 1964. Expenditures with Aerospace Corporation alone were $68,095,000 in FY 1963 and $74,210,000 in FY 1964.[23]

Maximum Transfer of Benefits to the Civilian Sector

In addition to its complaints concerning the increasing use of non-profit organizations, industry feels that the government should

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[22]Richard F. Roper, "Missile Managers. Aerospace Corp. Stirs Criticism of Pentagon's Use of Non-Profit Firms," Wall Street Journal, December 6, 1961, p. 1.

[23]U.S. Congress, House, Subcommittee on Appropriations Hearings, Department of Defense Appropriations for 1964, Part 6, 88th Congress, 1st Sess. (Washington, D.C., 1963), p. 140.

contract out for more of its research work. Industry's stand is that the government should be in a strong position to manage its research and development programs through the use of capable and responsible government personnel. However, it asserts that the government should manage only and contract for most, if not all, actual research. Management of research would not require staffs as large as those required for actual research.

This would enable greater use of the private sector as opposed to government-conducted research in its own facilities by its own employees. The view here is that this would enable maximum transfer of benefits from federally-sponsored research to the civilian economy. Recognition of this need for transfer is reflected in the establishment by the Atomic Energy Commission of the Office of Civilian Applications and of the National Space Agency of a similar office for the purpose of transferring findings and technology from government-sponsored research and development to civilian applications. This, however, is a distraction from the primary missions of military, space, or other objectives. The wide scope of possible civilian applications make these efforts problematical.[24]

Maximum transfer of secondary benefits from military or other government-sponsored research may be best achieved when a contractor is conducting the research in fields related to his regular commercial endeavors. Alternatively, if the government is conducting the research in-house or in a specially created institute or other quasi-public organization, direct transfer of benefits to the private sector is not possible

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[24]Holst, p. 164.

and any transfer will involve intermediate steps. Further, the incentive of opportunity for gain is absent, as are the means of production, distribution, and sale. Therefore, if the transfer of benefits to the private sector is an objective, the choice of the organization, whether government or private, should be influenced by these considerations.

Moreover, since it is desirable to transfer findings and technology to the private economy from government-sponsored research, restrictions on the use of such knowledge should be held to a minimum. Providing the work being done for the government is well-performed, any other advantages accruing to the contractor because of early involvement in the work of the government should be quite incidental. The opportunity to obtain such an advantage might very well be held out as an incentive for efficient contractors to undertake the project in the first place. If such work is opened fairly to all interested competitors, there should be no question as to the equity of the transfer of such know how; rather it should be encouraged in the public interest.[25]

Patent Policies

Similarly, there has been widespread discussion concerning what policy should be followed concerning the ownership of patents resulting from government-sponsored research and development. Is it in the public interest for the government to take title to these patents, data, and copyrights? Government justification for retaining ownership of patents is shown by the slogan, "What the government pays for it should own." Expressed differently, this statement asserts that because public funds

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[25] Ibid., p. 165.

were used in the creation of the invention, then it should rightly be the property of the public.

On the other hand, industry asks these questions. What is it that the government sought and paid for? Was it a weapon system or a patent? Did the government receive what it contracted for? Is the government entitled to ask for secondary or derivative benefits? Even more important, if the government takes title, will it promote the public interest? Industry contends that the private ownership of patents has led to their widespread use and has resulted in benefits which serve the government and the private aim of full employment, along with a continuing flow of new and better products, services, and production methods.[26]

Opposition to the view that industry should take title to patents resulting from government-sponsored research is based on the thesis that firms participating in this development obtain most of this work in a non-competitive atmosphere, without the inherent risks of truly private enterprise, but still want to use the patent system to obtain future control of new science and technology. The entitlement to these patents is considered a factor in the promotion of monopoly by some members of Congress. "Nothing less than the future of our free, competitive enterprise system is at stake."[27]

The Senate Subcommittee on Monopoly has asserted that most of the government-generated scientific knowledge is being locked up in the hands of a few large corporations. Other corporations, usually the smaller

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[26] Ibid.

[27] U.S. Congress, Senate, Subcommittee on Monopoly of the Select Committee on Small Business, Economic and Legal Problems of Government Patent Policies, 88th Cong., 1st Sess. (Washington, D.C. 1963), p. III.

ones and other industries, are being denied this knowledge for immediate and future use. Further, many of the discoveries, major and minor, are not being exploited by anyone--this includes cases in which both government agencies and industrial corporations hold patents which are not being put to use. Key government agencies, as well as corporations, have taken control of inventions that have resulted from the use of public funds. Without the proper institutional arrangements, the effective dissemination of the government's $15 billion a year research effort is not possible throughout society--to all companies, in all industries, regardless of location.[28]

The patent policies for the different government agencies vary. The Department of Defense, in its research and development contracts, allows the contractor to retain title to any patents resulting from the project with the government receiving a license to use the invention for government purposes. However, the corporation has exclusive use of the development for commercial purposes. This is known as the "license" policy. This differs from the "title" policy under which the National Space Agency operates. Under this concept, the government takes title to the patent and licenses corporations to use them on a royalty-free basis. The Atomic Energy Commission also uses this concept.[29]

Some members of Congress have considered modifying the law pertaining to the patent policy of the National Space Agency from the "title" to the "license" concept.[30] This has brought some protest from the

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[28]Ibid., p. 1.

[29]Lee E. Preston, "Patent Rights Under Federal Rand D Contracts," Harvard Business Review, Vol. XLI (September-October, 1963), 10.

[30]U.S. Congress, House, Committee on Science and Astronautics, Amending the National Aeronautics and Space Act of 1958 with Respect to Property Rights in Inventions, 87th Cong., 2d Sess (Washington, D.C., 1962), p. 1.

Subcommittee on Monopoly, which asserts that the unexpressed reason for this change is that the National Space Agency feels at a competitive disadvantage for the attention of contractors who may also be performing research for the Department of Defense. The Subcommittee feels that the proper course of action is to alter the policy of the Defense Department to the "title" policy.[31]

Need for a Single Patent Policy

Two major steps are advocated by this group to assure the most effective transfer of developments from government-sponsored research to the civilian sector. The first step is to have a common government policy which will require all agencies and departments of the federal government to take title to all patents on inventions resulting from government-financed research and development. The second and accompanying step is the establishment of an "Inventions Development Authority." This agency would have as its major functions the collection of scientific information, its analysis, and its development, including the collection of royalties on government-owned patents. Without such an agency, the retention of title by the government to a patent would not be very useful, for patents thus retained but not put to use would have no transfer value insofar as the civilian economy is concerned. For one of the current problems is the collection of dust by patents resulting from government-funded research, either in the files of the pertinent government agency or the drawers of a developing contractor. A recent study indicated that only about 13 percent of privately owned patents resulting from

[31] Government Patent Policies, p. 2.

federally-financed research and development had ever been licensed for use.[32]

It follows then that there is no systematic and efficient effort being made to exploit the ever-expanding flow of technical information. The limited efforts being made to distribute information originating in government research projects is being handled mostly by the Armed Services Technical Information Agency and the Office of Technical Services of the Commerce Department. These two agencies prepare and publish abstracts of research, but the efforts are rather limited. It is for this reason that the creation of an "Inventions Development Authority" is required for the purpose of developing and exploiting inventions from public research. This would be accomplished by making this technical information available to all of industry, rather than having it remain in the hands of the limited number of large corporations engaged in government research. Further, by charging royalties for the use of government-owned patents, part of the heavy costs of public research could be defrayed.[33]

The Subcommittee on Monopoly firmly believes:

> By taking title to patents where its resources represent the primary contribution and by establishing a new independent agency to exploit the technical information and inventions generated by federally-financed programs, the Government, meaning essentially the Congress since legislation will be necessary, could insure that the fruits of our $15 billion a year in research expenditures inure to the benefit of the general public.[34]

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[32] Ibid., p. 34.

[33] Ibid., p. 21.

[34] Ibid.

Summary

In summary, there are several impacts on society which may result from the developments of government-sponsored research, depending on how quickly and freely they are made available to the economy. The patent policy of the various government agencies do have a bearing on these impacts. It can be stated that there are benefits involved in giving title to patents to contractors performing research and development for the government. A stimulus is provided to companies for doing research and development, hence affecting resource use and development. When the government performs research in its own laboratories, the government, of course, retains title to any resulting developments. In the former instance under current conditions, the transfer to the civilian sector is much simpler and faster, since, in addition to the fees, the company receives an added know-how acquired on government contracts and also secures other competitive and financial benefits through a strong patent position and unrestricted commercial rights. On the other hand, there are some non-beneficial aspects of permitting a contractor to take title to patents developed in government research. The public may be excluded from or charged again for the use of products or processes to curb competition and foster monopoly because of the inclination of the Armed Services to contract with the larger companies. Although the government's non-exclusive licenses permit fulfillment of requirements anywhere, it is only natural that the Services tend to deal with those who have already performed satisfactory research work.[35]

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[35]Striner, p. 31.

In view of the expansion and changes occurring in all areas of federal research, it appears that government policy pertaining to patents will require some changes too. The answer is by no means simple, and much experimentation will be necessary to find an answer. On balance, experimentation toward expansion of the title policy with respect to federal research seems warranted. For the more widespread and the freer the dissemination of the results of public research to all potential users, the more effective will be its use. This, too, would provide the advantage of greater competition and economic growth.

In addition to the impact on our public policies, the great requirements for research and development are placing unusually high demands on the nation's pool of scientific and engineering talent. Competition for scientists and engineers, as indicated before, is becoming more intense. In addition to the more efficient use of scientific and technical personnel currently available, the expansion of education and training in these areas is extremely urgent. The university is of course the major participant in the education of engineers and scientists. These additional training requirements, plus the amount of reliance the government has placed on universities for the accomplishment of research, have had major consequences for our institutions of higher education. The total impact on a university can be sizable when federal funds provide more than half of the research budget, as may be the case. It is to the problems of providing adequate numbers of scientific and engineering personnel and the impact of federal research funds on the universities to which the next chapter will be devoted.

CHAPTER VI

MANPOWER, EDUCATION, AND THE UNIVERSITY

Requirements for Engineers and Scientists

Research and development requirements have placed extremely high demands on our pool of scientific and engineering manpower. These demands are related to the trend of the last ten years of increased federal requirements for research and development, particularly in the defense area for the development of modern weapons systems. In addition to the increased manpower requirements, which must be obtained almost entirely through our institutions of higher education, the federal government has come to rely heavily on the nation's universities and colleges to conduct increasing amounts of research and development work in defense as well as other areas. These two factors are having diverse effects on American universities.

Aside from the requirements of increased federal research and development, the newer industries such as those dealing in aircraft, missiles, and electronics supporting the weapons systems effort require a new kind of personnel mix, needing a higher percentage of scientists and engineers. Whereas the older type mass production industries require large numbers of production workers, the newer industries require roughly a one-to-one ratio between production workers and the scientist-engineer group and this proportion of scientist-engineers is steadily increasing.[1] This also intensifies the competition for these personnel.

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[1]Bell Report, p. 204.

The National Science Foundation indicates there is a 6 percent annual increase in the supply of scientists and engineers, while the number participating in research and development is increasing by 10 percent each year. Table 14 reflects the growth of scientists and engineers engaged in research and development from 1954 through 1960. The development of sufficient numbers of scientists and engineers is therefore very urgent for the welfare of the American economy.

Table 14. Scientists and engineers in research and development by sector 1954, 1958, and 1960[a]

Sector	1954	1958	1960
Total	223,200	327,100	387,000
Federal government[b]	29,500	40,200	41,800
Industry[c]	164,100	239,500	286,200
Colleges and universities[a]	25,200	42,000	52,000
Other non-profit institutions[a]	4,400	5,400	7,000

[a]Data consist of number of full-time employees plus the full-time equivalent of part-time employees.

[b]Limited to civilian personnel.

[c]Include professional research personnel employed at research centers administered by organizations under contract with federal agencies.

Source: U.S. National Science Foundation, 12th Annual Report (Washington, D.C., 1962), p. 140.

[2]Ibid., p. 208.

The economy relies on specialists in many fields, and there are urgent requirements for additional trained personnel in all the fields, but the technological challenges of the day place the heaviest demands on engineering, mathematics, and the physical sciences.[3]

Shortages of scientific and engineering talent is manifested by the intense competition among members of industry, government agencies, non-profit research organizations, and universities for the services of well-qualified people possessing these talents. This was mentioned briefly in the last chapter in regard to the government's inability to obtain sufficient personnel to conduct its own research and the necessity of forming non-profit research organizations for this purpose.[4]

The competition for scientific and engineering personnel may become more intense. The National Science Foundation points out that requirements for these talents will increase by about 85 percent between 1959 and 1970. An increased demand from 1,096,000 to about 2,032,000 is projected. For engineers, the increase projected is 90 percent--from 783,000 in 1959 to 1,484,000 in 1970. For scientists, a growth of 75 percent is expected over the 11 year period--from 313,000 in 1959 to 548,000 in 1970.[5]

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[3]U.S. White House, the President's Science Advisory Committe, Meeting Manpower Needs in Science and Technology, Report Number One: Graduate Training in Engineering, Mathematics, and Physical Sciences (Washington, D.C., 1962), p. 4. Cited hereafter as Graduate Training in Engineering, Mathematics, and Physical Sciences.

[4]See Chapter V, p. 97.

[5]U.S. Department of Labor, The Long Range Demand for Scientific and Technical Personnel (Washington, D.C., 1961), p. 27. Cited hereafter as Long Range Demand.

The increase from 1,096,000 in 1959 to 2,032,000 in 1970 means an increase of an average of 85,000 scientists and engineers yearly is required. In addition to this number, there will be requirements to replace those in these professions who retire, die, or transfer to other fields of work. It is anticipated that this will average approximately 21,000 a year during the 1960's. Thus, there will be a total average requirement of 106,000 new scientific and engineering personnel each year--85,000 for new requirements and 21,000 for replacements. The requirements for engineers is the greatest, for it is estimated that the demand will be for 81,000 new engineers each year. Also required during this period are an average of 25,000 new scientists each year. Experience has shown that about 23 percent of all new entrants into the engineering field are without engineering degrees and there is a loss of about 4 percent of all engineering graduates to other fields. Based on this data, there will still be a yearly average requirement of 72,000 engineering graduates during this period.

This estimate of 72,000 is well above the actual number of engineering graduates in 1960 which totalled 37,808 bachelor's, 7,159 master's, and 786 doctor's degrees awarded. An 80 percent increase in requirements for all fields of engineering is projected between 1959 and 1969, assuming that the necessary educational facilities and faculty are available. Based on this projection there would be an annual average output of 58,000 engineers making a total of 631,000 for the 11-year period. This does not meet the projected demand of 72,000 per annum.[6]

There is further evidence that the projected demand does not

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[6] Ibid., p. 33.

appear to be possible of fulfillment within the projected time span. In 1963 the number of engineering students receiving bachelor degrees in engineering declined for the fourth straight year, although there appears to be some evidence of slowing or reversal of this trend. One promising factor was the increase in the number of doctor's and master's degrees awarded in the 1962-63 academic year. However, the engineer's Joint Council, through its president, stated that these increases were not great enough to insure replacement of retiring faculty and to provide upgrading of aculties and to satisfy the needs of government and industry for engineers educated to a high level of competence.[7]

If the projected demand is to be met, the proportion of freshmen enrolling in engineering needs to increase, retention rates improve, transfers into engineering schools rise, or some combination of these factors take place. If none of these occur, then some of the deficit might be made up by an influx of a greater number of persons without engineering degrees than the 23 percent that has been allowed above.[8]

A similar situation exists in the scientist requirements. Although an annual average output from our universities is projected at 80,000 degrees in various fields of science, past experience reveals that about 70 percent of those with science degrees do not obtain work in one of the fields of science. To meet a projected requirement of 25,000 scientists per year during the 1960's would require an average annual output of 83,000 science graduates which roughly approximates

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[7]"Classroom and Campus," New York Times, November 24, 1963, Sect. IV, p. 7.

[8]Long Range Demand, p. 33.

the 80,000 anticipated output. However, this figure does not take into account the differences in the supply and demand situation among the various science specialties and among the different levels of education. Employers' demands for advanced degrees indicate there may be a considerable gap between the supply of and the demand for these personnel. In addition, the supply-demand situation in some science specialties may be far different than that indicated for all scientists as a group.[9]

The Need for Quality and Advanced Training

Apart from the numbers of scientists and engineers required to support the government's military, economic, and social objectives, the President's Science Advisory Committee in a report to the President, voiced concern about the nation's needs for professional personnel with high ability and advanced training. The Committee urged the adoption of four major goals in engineering, mathematics, and the physical sciences, as follows:[10]

1. To increase the awards of doctor's degrees to reach 7500 per year by 1970 (Table 15).
2. To increase the number of students who receive a full year of graduate training to reach 30,000 annually by 1970 (Table 15).
3. To strengthen existing centers of educational excellence in engineering, mathematics, and physical sciences, and develop new ones.
4. Promote wider geographic distribution of centers of educational excellence.

The increased number of graduate students related to the first two goals will require an increas in the present capacities of first-rate

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[9] Ibid., p. 34.

[10] Graduate Training in Engineering, Mathematics, and Physical Sciences, p. 6.

Table 15. Numbers achieved and goals for the future in graduate education in engineering, mathematics, and the physical sciences[a]

	Achieved			Goals			
	1950	1960	1962	1964	1966	1968	1970
First-year graduate students[b]	--	17	20	30 (22)[c]	35	38	40
Master's degree recipients[d]	9	12	13	16 (15)[c]	24	27	30
Graduate students beyond first year[b]	--	17	20	24 (22)[c]	31	36	41
Doctor's degree recipients	2.1	2.9	3.4	3.9 (3.9)[c]	4.7	5.7	7.5

[a]Number of persons (thousands).

[b]Full-time students, defined as students engaged in at least 3/4 of the normal work-load.

[c]Numbers in parentheses give expected 1964 levels, based on continuation of past trends.

[d]Taken as roughly equivalent to the satisfactory completion of one year's full-time graduate study.

Source: U.S. White House, The President's Advisory Committee, Graduate Training in Engineering, Mathematics, and Physical Sciences (Washington, D.C., 1962), p. 7.

educational institutions. The attainment of the third goal is therefore essential if the first two are to be achieved. This will require the more effective use of recognized centers of excellence and in encouraging and making possible their expansion. However, this alone is insufficient, for a further requirement will be to recognize and develop new "centers of excellence."[11]

[11]The President's Science Advisory Committee considers a center of educational excellence as ". . . one that offers first-rate educational training may comprise an entire institution, a department, a group of faculty, or one distinguished man."

The fourth goal will allow increased enrollments to be more evenly distributed geographically. Centers of excellence more evenly distributed will be able to serve all geographic areas more effectively. These educational centers serving more regions and states would stimulate and spread economic progress because recent experience indicates that new industry has a tendency to concentrate around leading institutions of science and technology.

The attainment of these four goals will require a major input of funds, both federal and non-federal. The limitations to their achievement are--availability of student support, numbers of faculty, and educational facilities. Students with family responsibilities, faced with a choice between reasonable starting salary and a much smaller stipend which they may receive to pursue graduate studies, often decide they cannot afford to select graduate study. Those who do choose graduate study, must often combine it with a job and extend their study over many years. The Committee recommends that stipends be sufficient in number and size to attract more students into full-time graduate study, thereby allowing a shorter interval to obtain a doctor's degree and making them available for full-time professional work at an earlier date.

Another requirement is increased funds for buildings and equipment. Effective graduate training requires these facilities if the goals to accommodate increasing numbers of students are to be met. Because the lead time is long and present facilities are inadequate to meet increased student enrollments, the provision of funds for this purpose is the first order of business toward attainment of the proposed goals.

The achievement of these goals must not be permitted to distort the broad responsibilities of the universities for education at undergraduate and graduate levels, and in all academic fields, including the social science, arts, humanities, and sciences. To prevent such distortions, the universities must be reimbursed, through an effective program, for the increased costs of increased graduate training in the engineering, mathematical and physical sciences. The program must operate to supplement, but not replace, funds from other sources of support.[12]

To achieve the aforementioned goals, the Committee recommends a national program which would provide:[13]

1. Adequate financial support for all full-time graduate students in these three fields;
2. Funds to cover the full costs of graduate education in engineering, mathematics and physical sciences;
3. Funds for physical facilities and equipment used;
4. Funds for developing new centers of education.

It is suggested that the federal government take the lead and perhaps provide 60 percent of the support for this program. The remainder would come from the states, industry, the foundations, and private donors. The federal government has become the principal consumer of the output of engineering, mathematics and physical sciences schools. Large government projects have greatly increased the demand for professional manpower. However, it is insufficient for the government to establish agencies and let contracts to accomplish these projects. It must insure

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[12] Graduate Training in Engineering, Mathematics, and Physical Sciences, p. 6.

[13] Ibid.

that high caliber and well-trained people are available to work in these agencies and under these contracts. Therefore, the federal government must take the initiative and the central responsibility for supporting this effort.[14]

Magnitude of Federal Expenditures on Universities

The current federal expenditures for research and development at universities and colleges, plus the support required by the proposed program for expanding graduate study and facilities are indeed large. The costs for this program are projected to grow to $760 million for the year 1970 (Table 16). The proposed 60 percent contribution by the government, mainly through the National Science Foundation, for the graduate training program adds to an already tremendous participation by the government in funds expenditures with our universities and colleges for basic and applied research as well as for development.

The magnitude of these expenditures can be gleaned from Table 17. It is to be noted from Table 17 that the Department of Defense ranks third in its expenditures for research and development with educational institutions; however, much of the expenditures of the Atomic Energy Commission and the National Aeronautics and Space Administration are for national security purposes, which indicates that expenditures for weapons development exceed by far the expenditures for any other single purpose. In any discussion related to the impact of federal research funds on universities, it is difficult to separate the impact of expenditures for weapons research and development per se from the cumulative

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[14] Ibid., p. 14.

Table 16. Total cost of recommended national program for graduate training in EMP, through fiscal year 1970[a,b]

	Fiscal year 1964	Fiscal year 1966	Fiscal year 1968	Fiscal year 1970
Student support[c]	$185	$230	$260	$285
Cost of education[d]	145	180	200	225
Construction and equipment	250	250	250	250
Total	$580	$660	$710	$760

[a]Millions of dollars from all sectors.

[b]Not including funds for research that is conducted as an integral part of graduate education.

[c]Includes student support in the form of research assistantships paid out of research grants or contracts. Stipends cover cost of living on an 11-month basis, including allowances for dependents.

[c]Includes tuition and additional allowances for faculty salaries, laboratory operations, building maintenance, administrative services.

Source: U.S. White House, the President's Advisory Committee, Graduate Training in Engineering, Mathematics, and Physical Sciences (Washington, D.C., 1962), p. 11.

Table 17. R&D obligations to educational institutions, by selected agency, fiscal year 1962 (estimated)

	Amount (millions of dollars)	Percentage distributions	Obligations as percentage of agency's R&D obligations
Total, all agencies	$1,283	100	12
Atomic Energy Commission	335	26	32
Department of Health, Education & Welfare	324	25	54
Department of Defense	313	24	5
National Aeronautics & Space Administration	180	14	13
National Science Foundation	86	7	81
All other agencies	45	-	-

Source: U.S. National Science Foundation, Federal Funds for Science, XI, 1963 (Washington, D.C., 1963), p. 20.

effect of all federally sponsored research. Since research expenditures for defense purposes make up the bulk of the expenditures, no attempt at separating this impact will be made since the basic effect of all types of federal research is similar.[15]

Effects on Teaching

Many feel that the stress on research work and graduate training is causing undergraduate work to suffer. It is asserted that the expenditures for government research, student support programs, and the comitment to post-graduate support of virtually the entire source of new

[15]See Table 12, Federal expenditures for Research and Development for fiscal years 1953-1963, Chap. V.

scientific manpower are distorting the educational system.[16] By absorbing the best graduates, government research projects are leaving many universities dependent on the lowest caliber graduate students to perform the role of instructing undergraduates. There is evidence that the support made available through fellowships, grants, and sponsored research are making it extremely difficult to find teaching assistants who have traditionally been one of the major methods of teacing undergraduates.[17]

Further, the "research outlook" of federal programs is changing the academic scientist's job by de-emphasizing teaching. Furthermore, the emphasis on research tends to increase class sizes and thereby reduce student-teacher contacts and helps increase faculty needs, by reducing each faculty member's availability for class work.[18]

Federal research funds make up a substantial part of the operating income of universities. The sheer volume of money affects what they teach, how they teach, and the quality of instruction. Apart from the effects of the federal funds that they receive, they are also influenced by the total volume of federal research and development expenditures. For example, federal funds have created a demand for engineering and scientific manpower which has drawn many university teachers and potential teachers into industrial research. These effects are not temporary and will probably become more powerful.[19]

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[16]Edmund K. Faltermeyer, "Cash for Colleges," Wall Street Journal, December 6, 1961, p. 1.

[17]Federal Influence Distorts Education, Nation's Business, Vol.51, No. 3 (March 1963), p. 31.

[18]Ibid., p. 32.

[19]Charles V. Kidd, American Universities and Federal Research, (Cambridge, Mass.: The Belknap Press of Harvard University Press, 1959), p. 39.

Freedom of the University

Another issue having long term effects is whether it is possible to have strong free productive research in the university structure when most of the money comes from federal sources. The sheer volume of funds creates pressures of the utmost importance in universities. If federal financing of research leads to a loss of freedom by universities and by investigators, the universities and the scientific community are in a precarious position.[20]

There is little doubt that university research in all fields is more extensive and in most fields of higher average quality. However, the amount and complexity of the total research effort does not seem to have stifled the individual. Large amounts of federal funds are being provided for basic research--basic in the sense that investigations are not limited to an immediate practical end, and that scientists are free to pursue their own lines of investigation. Competent scientists using federal monies are permitted to do the research they want to do. Basic research is better financed in this country than ever before.[21]

Basic Research

Basic research has been variously defined. However, the following definition provided by the National Science foundation is considered the most appropriate.

> Basic research is that type of research directed towards increase of knowledge in science. It is research where the primary aim of the investigator is a fuller

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[20] Ibid., p. 53.

[21] Ibid., p. 211.

> knowledge or understanding of the subject under study, rather than a practical application thereof.[22]

Despite the large amount of government research funds, the freedom of the university and individual scientists has not been curtailed, but has, in many respects, been extended through their use. Although the federal government may have threatened constantly to distort universities by giving greater emphasis to applied or developmental than to basic research, the process of mutual adaptation has kept the threat a potential one.[23]

Government-sponsored research administered by the various government agencies, and in particular the Department of Defense, has had a greater interest in applied and developmental research than in basic research. Since the aims of applied and developmental research meet the requirements of the mission-related programs of national defense and other public purposes, it was often indicated that the universities were participating in too great a portion of this type research as compared to the amount of basic research being accomplished.

This excessive participation in applied research was felt to be a detriment to the creation of knowledge, one of the prime aims of a university, along with the preservation and transmission of knowledge. However, American universities also have a strong tradition of service to the community and feel an obligation to help governments, state and local industries, and economic and social groups solve immediate problems. It was therefore inevitable that the federal agencies would

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[22]U.S. National Science Foundation, Federal Funds for Science IX, (Washington, D.C., 1960), p. 24.

[23]J. D. Millett, Financing Higher Education in the United States (New York: Columbia University Press, 1952), p. 335.

turn to the universities and that they would respond to the needs of the government.[24]

However true that the emphasis on applied and developmental research may have been in the past, and it may also be true today, it would be difficult to arrive at a conclusion that basic research is being neglected. An examination of this area revealed that universities are getting more federal support for basic research than ever before. The magnitude of these expenditures with universities is reflected in the rising expenditures of the past three years going from approximately $415 million in fiscal year 1961 to an estimated $578 million in fiscal year 1962, and an estimated $778 million in fiscal year 1963. It is also interesting to note that 52 percent of all federal funds ($1.12 billion) for basic research obligated in fiscal year 1962 was distributed among the universities, up from 41 percent in fiscal year 1961.[25]

Objectives of Federal Agencies vs. Objectives of Universities

However, there is a degree of incompatibility between the objectives of the individual federal agencies and those of the universities since federal agencies have functions that are not necessarily best discharged by acting in a way most congenial to the universities. These objectives range from provision of the national defense to promotion of the general welfare while those of the universities are

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[24]Kidd, p. 26.

[25]U.S. National Science Foundation, Federal Funds for Science XI (Washington, D.C.,1963), pp. 127-129.

education, research, and community service. As these broad purposes have interacted on one another since World War II, especially in contract research, there has been much debate over the government-university research relationship.[26]

One area of debate over federal project-oriented research is that the project system transfers control of the directions which inquiries should take from the institutions to the government agency which approves and disapproves projects. Projects and their sponsors have been accused of taking away the prerogatives of the universities performing government research under contract, and there have been pressures to give the universities greater control over research through the use of grants, rather than through contracts.[27]

The Use of Grants or Contracts

The two methods used by the government to obtain research services are by the use of contract and the other by the use of grants. Under the contract method, the "product" purchased is research--although grants may also in effect purchase research. The research contract is considered by many an imperfect instrument for this purpose with its concept of services purchased and its inherent red tape and government administration.[28]

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[26]U.S. National Science Foundation, 11th Annual Report (Washington, D.C., 1961), p. 153.

[27]Paul Lancaster, "Guilding the Ivy," Wall Street Journal, February 19, 1960, p. 1.

[28]U.S. White House, The President's Science Advisory Committee, The Universities and the Federal Government, November 15, 1960, p. 8.

The grant method is generally considered to support research rather than purchase it--although this distinction is more imaginary than real. Generally, however, grants are provided for the pursuit of research having broad objectives rather than for a specific project. On the other hand, contracts have also been let in recent years for broad objectives with relatively long-time schedules for completion. However, the use of grants allows the university greater flexibility and freedon and there is inherently less red tape and government administration involved. For these reasons, the grant is generally preferred.[29]

Overhead Costs

One disadvantage of the grant is that it often fails to provide for the full cost of the research that is supported, mainly because Congress has placed a 20 percent limitation on overhead costs in connection with research grants. Because of this, there has been a recent trend by some universities to refuse grants for some research when offered, but to accept a contract for the same research. In the fiscal year 1963, the Army indicates that 57 grants were refused and contracts had been awarded in lieu thereof. The amount of these refusals totaled $2,774 million. During the same period, the Air Force had 12 refusals amounting to $549,945 because of the 20 percent limitation. As an example. Princeton University accepted a contract for $270,700 in lieu of a grant for which it was allowed overhead

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[29] Ibid.

rates of 70 percent based on a percentage of salaries and wages.[30]

From this trend it is evident that many universities do not consider the governmental contractual arrangements too burdensome at this time. However, the number of grants being accepted by far outnumbers those being rejected, so it is also true that most universities' preference for this arrangement outweighs the objection to the absorption of some costs. The Air Force estimated that in its grants, the universities absorbed overhead costs of almost $2 million and to this extent supported the government in its research effort.[31] The major issue is the question whether the government should pay the full cost of the research it sponsors or whether the university should sometimes contribute to this cost. In addition to payment of direct costs of equipment, materials, salaries, etc., is the government obligated to pay for indirect costs reasonably attributable to government financed projects? Allocation of overhead costs is difficult and there is no magic formula which can provide the answer. However, the costs are real and any university taking on a large volume of government research without seeking payment of indirect costs would certainly find itself in serious financial difficulty.[32]

The Department of Defense policy in this regard is to pay full overhead costs, if possible. The Secretary of Defense stated, however:

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[30] U.S. House of Representatives, Subcommittee of the Committee on Appropriations, Hearings, Department of Defense Appropriations for 1964, Part 6, 88th Cong., 1st Sess. (Washington, D.C., 1963), p. 116.

[31] Ibid.

[32] Alice M. Rivlin, The Role of the Federal Government in Financing Higher Education (Washington, D.C.: The Brookings Institution, 1961), p. 52.

> This is why I say that the universities are subsidizing the Department of Defense. Because our payments to the universities for research which they conduct at our request arenot large enough to cover the costs of brick and mortar.[33]

Benefits to the University

The acceptance of research projects, whether through grants or contracts, is advantageous to the universities in many respects. The incidental benefits may include enhancement of faculty and institution prestige, exploitable patents, support of graduate students through research assistantships, and freeing of general university research funds for departments, mainly arts and humanities, which receive little or no federal support. Further, institutions because of sponsored research programs, can attract and hold better instructors and graduate students. These are real benefits, even though they cannot be priced. Direct benefits are generally related to the addition and construction of research facilities and equipment.[34]

Advancement of National Objectives

The total sum of all federally-sponsored research, whether in support of university research through grants for projects not relevant to any specific goal or a federal agency or in direct support of a specific task of such an agency, can be considered a declaration of national objectives and an expression of national policy. The involvement of universities in federal research is not entirely to help

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[33]U.S. Senate, Subcommittee of the Committee on Appropriations, Hearings, Department of Defense Appropriations for 1964, 88th Cong., 1st Sess (Washington, D, C., 1963), p. 170.

[34]Rivlin, p. 44.

them to do more of what they wish, but to involve them in the achievement of national goals established by the government. When research unrelated to a specific federal agency's objective is supported, it is to expand the nation's research resources, which is a declared national policy. Since unrelated research and the support of a specific research project to further a federal agency's objective both further national objectives, these two considerations may warrant the full payment of all costs for federally sponsored research despite the benefits accruing to the university in pursuing such research.[35]

Protection for the University

An opposing view to the full payment of all costs, is based on the view that cost participation by the university is essential in order to protect the university from undue federal influence or control, and further because of the benefits received--both direct and indirect. It is thought that through university cost participation, the faculty members involved in the research and the institution will be in a stronger position to resist any effort on the part of the federal agency to control that research. In such a situation, the fact that the university paid 10 to 20 percent of the research cost would not alter the situation very much. Compulsory cost participation could indeed restrict the freedom of the university and its faculty members. In some instances this cost participation in federal research might reduce the volume of research supported entirely by the university. The only major protection for a university engaged in

[35]Kidd, p. 93.

federal research to retain a substantial degree of freedom in its research program is to obtain a substantial part of all programs from non-federal resources. Further, when performing federal research, it must insist on favorable terms and conditions which will allow them to retain a high degree of control of their own affairs.[36]

The breadth of federal authority and the breadth of the missions of the federal agencies and the amount of money available to finance research in universities are in many respects a protection to them. This money has been provided for virtually all kinds of research. This has resulted in reduced tendency for the possibility of university control by federal agencies. Exertion of individual pressures by agencies to increase the amount of research of interest to them has resulted in greatly nullifying the number and variety of pressures from all agencies combined. Similarly, the large number of agencies which support work, often of the same kind, protects scientists and universities. The principle of diversity of research support has been adopted by the government and this provides the competition so necessary for protection.[37]

The major threat to the freedom of universities is not the exercise of arbitrary authority of government bureaucrats but the effect that federal funds have on the universities in resolving problems such as: (a) exertion by universities of countervailing forces against the pressure to expand the physical sciences; (b) the implications of expanding the volume of research on the capacity of the

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[36] Ibid.

[37] Ibid., p. 213.

universities to teach the impending wave of students; (c) how to attract and retain teachers with research talent when competing with industry, substantially supported by federal money; and (d) how to withstand the temptation to accept federal funds which would divert them from their primary functions.[38]

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[38] Ibid., p. 228.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The Unpredictability and the Constraints

The large expenditures of the United States for the development of modern weapons systems along with outlays for their logistics support, manning, and deployment have had a major impact on the nation--its economy, its institutions, and its people. Certainly very few activities, if any, have remained unaffected.

A large segment of American industry has been affected because development of modern weapons systems is conducted in an environment that is unique in character and quite different from ordinary commercial activity. The control of development time, ultimate costs, and the quality of a major weapons system has been fraught with unpredictables. The fact that major development programs have suffered cost escalations of 200 to 300 percent and schedule slippages of one to three years--when measured against original targets--is well known to government and industrial managers. Since much of the effort involves research and development activities, whose outcomes have been generally unpredictable, the uncertainties have existed to a greater degree than in the ordinary industrial environment. Further, the development which is sought attempts to discover a new and different technology and demands an order of magnitude of improvement over anything achieved before.

Advances in technology may make the program obsolete and thus

cause its termination. Changes in defense policies, budget changes, changes in officials, and change in the intelligence of enemy capabilities, among others, may cause the alteration or even the cancellation of the program. These uncertainties have introduced a large element of uncertainty for those engaged in the weapons business.

In addition to the risks introduced by these uncertainties, the weapons market is also peculiar to the extent that the government is the sole purchaser of weapons systems. The weapons market bears little resemblance to the consumer or commercial markets because the government, as the buyer, prescribes the product it desires rather than the entrepreneur offering specific products for sale.

Because the government is the sole buyer of weapons products and can exercise the power of a monopsonist and because the nature and performance of the product is considered so critical, constraints have been placed upon the defense industry which are not customarily found in private industry. Some contracts for weapons systems specify not only what is to be produced, but also how and with what materials, how much subcontracting is to be done, and who the subcontractors are to be. Government personnel in residence at the industrial site constantly monitor all aspects of development, production, and costs in many cases. The government-industrial relationship in development programs is quite unlike any situation in the civilian sector. Although industry would like to have this relationship relaxed to some extent, it is unlikely that this will occur in the foreseeable future because of the complexity and performance requirements of the product, the high costs involved, and because of the many uncertainties which necessitate constant changes in the product.

Although these uncertainties pertaining to time, cost, and quality outcomes have existed for an extended period, the current view by the Department of Defense is that these problems have been due mainly to inadequate planning and treating all development projects in an identical manner. Consequently the basic concept of development work has been reorganized. This concept briefly requires that before any large scale development work takes place that a single plan be established which defines what is wanted, what the design will be, when it is wanted, how it is to be built, and the cost of the program. Further, a description of the management techniques to control the project is also required. This concept is known as "project definition."

Through the use of "project definition" the increased use of incentive type contracts is possible. By providing contractors with incentives for increased profits, it is hoped to improve performance factors of the end product, improve deliveries, and reduce costs--those things which have been the major problems in the past.

In conclusion, the adoption of "project definition," with its precise establishment of the program, including the management techniques to be used in control of the program is an indication that close surveillance and control of development contracts will continue indefinitely.

The Changing Geography

Over the past decade the product mix of weapons systems has evolved from wheeled-type weapons, conventional arms and munitions, to complex aircraft and missiles having a heavy reliance on electronics. This has resulted in a major impact on a large section of the American

economy. The location of those industries which provide weapons products to the government has changed as a result of the evolution which has taken place in weapons systems. The East, North Central, and Middle Atlantic states have been the major losers of government business in the weapons area, while the Mountain and Pacific states have been the major gainers.

These geographical shifts have had major consequences for the areas involved. Those areas which have gained business as a result of weapons contracts have often been faced with the problems of rapid growth, while they have also been faced with problems of reduced spending on major weapons programs. These reductions have, in many instances, resulted in a high rate of unemployment for specific communities and cities.

There has been concern over the effects of reduced defense expenditures not only for individual areas and industries but also for the total economy as well. As a result of this concern, a national study group, The United States Arms Control and Disarmament Agency, has been established to prepare for the possibility of reduced expenditures for defense purposes. Further, studies are being conducted to ascertain the effects of shifting defense procurement and what to do about minimizing them.

The Small Business Community

In addition to the geographic concentration of military spending, there has been a tendency for the concentration of defense contracts in the hands of a relatively small group of large corporations. This has

raised fears of the possibility of monopoly, and Congress and the Executive Branch have insisted on the establishment of programs within the Department of Defense, the Small Business Administration, and other government agencies to assure that small business receives a "fair share" of government business.

The small business program encompasses numerous activities such as financial aid, management, and other types of executive counselling, as well as aid in obtaining government contracts. Aid in obtaining government contracts was born out of concern over the impact of military procurement upon the economic structure of the nation because of the magnitude of the dollar volume of such buying.

This concern increased when, in the face of mounting expenditures for defense, the small business community continued to receive a declining share of government contracts. The change from traditional concepts of warfare to the concepts of the atomic and space age was changing the procurement pattern of the services. Henceforth, the major portion of expenditures would be for complex missiles and aircraft and electronics systems, while such items as subsistence, textiles, clothing, and conventional weapons would receive a lesser share. Since small business is unable to fully cope with the complexities of developing a major weapons system, this result was inevitable. However, the many programs designed to provide small business with additional government business have done much to offset the effects of weapons system procurement on small business.

Research and Development

Expenditures for government-sponsored research and development approximates 75 percent of the total dollars spent for this purpose in the United States. With only 25 percent of these expenditures devoted to objectives purely for the civilian sector, industry has shown some concern that the concentration of research and development for government objectives has caused a serious imbalance and may cause lagging employment in the future and may deter productivity increases. Industry is concerned that the huge requirements for scientific and engineering personnel for government research is diverting these scarce skills from industry with consequent damage to the economy at large.

On the other hand, there is the belief, shared by the author, that without the stimulus of government-sponsored research, the resource base of scientists and engineers would not be as large as it is. Further, there is much documentation to show that research for military purposes has resulted in major benefits to the civilian sector in new inventions, new processes, and in increased productivity. The difference between military research and civilian research is much less real than actual. Nevertheless, it is deemed necessary that the primary benefit to be derived from military research is a strong defense posture and any other benefits to be derived are secondary in importance.

The University

In addition to the reliance on colleges and universities to provide the scientific and engineering manpower required for research

and development, the government has come to depend on these institutions to perform an increasing amount of research and development work in defense as well as other areas.

It is felt that the stress on research work and the absorption of the best graduates for government-sponsored research are leaving many universities dependent on the lower caliber graduate students to perform undergraduate teaching. Further, many of the best faculty members are so involved in research work that their services are all but lost to the teaching mission of the university. By reducing the number of professors and the time of some which can be made available for teaching, class sizes are necessarily enlarged, thereby reducing the teacher-student contact. Further, the demand that federal research and development requirements have made on scientific and engineering personnel have drawn many university teachers and potential teachers into industrial research work.

There has also been concern over the ability of the universities to provide the required personnel for the future needs of the nation in the scientific, engineering, and mathematics areas. The need for funds assistance to provide increased and improved facilities to the universities has been recognized and some proposals have been advanced for federal aid.

Since there is already a large amount of federal funds going to universities for the performance of research and development tasks for the government, there have been fears that there is danger that the freedom of the university is being threatened. The large volume of federal funds does create pressures on the universities. However,

there has been a diversity of research and development because of the different types of research being sponsored by the various agencies of the government. Thus, the exertion of individual pressures by various government departments to increase the amount of research of interest to them has in a sense nullified the number and variety of pressures from all agencies combined.

It would appear that the monies being spent by the federal government have provided the means for more extensive research and of higher average quality. Further, there has been no great restriction of individual freedom in the pursuit of basic research--that is, research which is not confined to an immediate practical end. Scientists are permitted to do the research they desire to do--and with federal funds. Although the pressures have been there, the danger of the loss of freedom to the university has only been a potential one.

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